February, 1959

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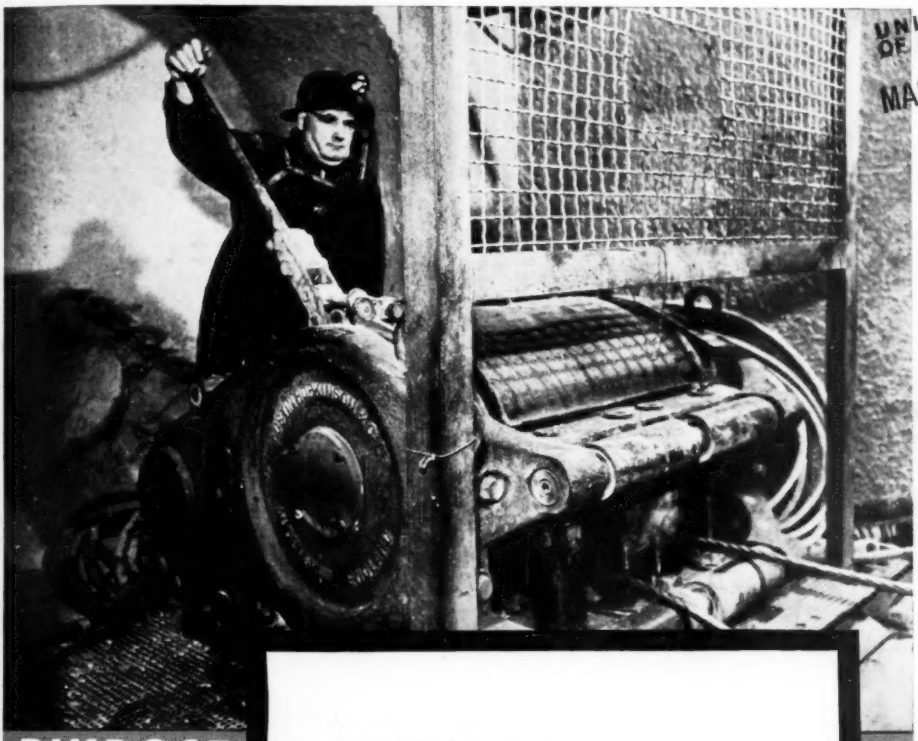

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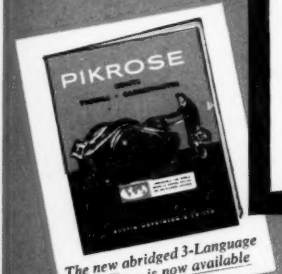

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EDITORIAL

IT has been announced by the Institution of Mining and Metallurgy that it is proposed to make grants in the current year from the Bosworth Smith Trust Fund to assist post-graduate research in metalliferous mining, excluding mineral dressing but including surveying and geophysical prospecting. Projects may be supported for more than one year, it is stated, and applicants for grants are asked to write for a form of application to the Secretary of the Institution before February 28.

AN eighth edition of the mineral map of Canada, which is in colour, has been issued by the Department of Mines and Technical Surveys.[1] Over 230 mines and 130 oil and gas wells are indexed and the value of Canada's principal mineral products during 1957 are illustrated. A table outlines the value of mineral production by provinces and seven inset maps show the locations of iron blast-furnaces, ferro-alloy plants, and non-ferrous metal smelters and refineries, as well as important potential producing areas throughout Canada.

THE Department of Scientific and Industrial Research recently announced that expenditure on research is to be nearly doubled in the next five years. Under its second five-year plan, for the period 1959 to 1964, approximately £61,000,000 is to be made available to the Department, as compared with £36,000,000 for the first quinquennium which ends on March 31 next. The largest expansion is planned in scientific grants to the universities. Post-graduate awards to students are to be increased by about 10% each year until, in 1963–1964, it is hoped some 3,800 students will be receiving D.S.I.R. grants for research training. In the same year it is expected that department's support for special work in the research departments of universities will be operating on a scale of about £1,750,000 per annum.

[1] No. 900A. Free ; 25 cents per additional copy. Mines Branch Publications Distribution Office, Ottawa.

IT was recently announced in Canberra that the Bureau of Mineral Resources has now made its report [1] on the Tennant Creek field available to industry. Generally speaking it describes the main features of the geophysical surveys carried out in the region from 1935 to 1937 by the Aerial, Geological, and Geophysical Survey of Northern Australia, since disbanded. However, the Bureau has maintained its interest in the field in subsequent years and has carried out further geological and geophysical surveys, while geochemical testing was carried out in 1956 and 1957 and a detailed geological survey made in 1958. In contrast with the earlier investigations, which, it is stated, were concerned primarily with gold, the work since 1956 has been directed towards establishing the potential of the Tennant Creek area as a base-metal field.

ATTENTION has already been drawn here to the mining machinery exhibition which is being held in London from July 9 to 18 next under the auspices of the Council of Underground Machinery Manufacturers and to the Symposium on Shaft Sinking and Tunnelling arranged during the period by the Institution of Mining Engineers. The sponsors of the exhibition recently announced that exhibits on some 100 stands will cover all kinds of mining equipment and intimated that applications of hydraulics and many other British developments will be displayed, including improved power-loaders with continuously rated water-cooled motors, new designs of feeder conveyors, and the latest types of drilling, cutting, conveying,

[1] Bulletin No. 44, Bureau of Mineral Resources, Melbourne, Canberra, and Darwin.

and loading machinery. As for the symposium, it is evident that this has attracted a wide interest and papers are to be submitted by engineers from Australia, Canada, South Africa, France, Western Germany, Holland, Poland, Sweden, the U.S.A., and Russia, as well as from the National Coal Board and industrial concerns in this country. Some 19 papers are to be presented and many aspects of the two subjects will be covered. Sir James Bowman, chairman of the National Coal Board, is to open the symposium.

Mine Safety

The 36th annual report of the Safety in Mines Research Establishment, covering 1957, has recently become available.[1] The mining industry in this country being predominantly interested in coal, most of the review presented is directed to work in that mineral but some of the subjects reviewed—in regard to pneumoconiosis, strata control, and engineering and metallurgical topics—will be of interest to metal-mining men. In his introduction to the report under review the Director of the Establishment, Mr. H. T. Ramsay, refers to the deliberations of the Safety in Mines Research Advisory Board, which has as its task the direction of the work of the Establishment so that a proper relative balance is preserved towards the various problems. Dust suppression was specially discussed, it is stated, and the safety problems arising from the increasing rate of coal extraction. The safety problems of rope haulage were also considered and a subcommittee was appointed to review haulage-accident statistics and to recommend any necessary changes in their compilation and classification. The Board also reviewed research on metallurgical problems, colliery wire ropes, and strata control and on the development of breathing apparatus and of non-inflammable hydraulic fluids, while a working party was appointed to examine the various properties required in such fluids to ensure both operational efficiency and safety. Collaboration with research establishments in Europe and America is most cordial, it is stated, and in September there was an informal meeting of directors at which individual research programmes on safety were tabled and discussed.

In respect of work on dust control and the pneumonoconiosis hazard it is noted that the Continental method of finding the dust hazard in the air of a coal mine is to measure the concentration of the dust and to find its composition, while the British method is directed to measurements of concentration. However, as rock dust is believed to be generally a greater hazard than coal dust the permitted dust standards in Britain for rock work are more stringent than those for coal work and an investigation is now being carried out to assess the variability of dust composition in British coal mines. Some progress has been made with dust analysis by optical microscopy since, in a sample illuminated simultaneously by transmitted and reflected light, coal particles can be made to appear dark and mineral particles light on a neutral background. As regards work on the properties of quartz and other forms of silica which might be related to their ability to produce the specific form of nodular fibrosis which characterizes silicosis evidence continues to mount against the silica-solubility theory of silicosis ; the alternative—*i.e.*, the surface activity theory—is at present being explored by adsorption studies.

Reference should also be made to work on strata control, which arises mainly out of the fact that about half the accidents occurring in British coal mines have been due to falls of ground, particularly near the face. The extraction of large areas of coal makes problems more complex and none of the theories of ground behaviour at present considered seem likely to present full explanations of strata behaviour. All such theories, it is considered, are incomplete ; the arch theory, for instance, does not include an explanation of the mechanism by which the arch forms, it is suggested, and the consequences of the soil mechanics and beam theories have not been fully worked out. The arch theory does not exclude a soil-mechanics mechanism and arching has been demonstrated on a small scale in soils, but it is possible that arching may also occur on a larger scale in masses of broken rock. Thus, although the theories have been developed separately, the report says, they may not be incompatible and may ultimately be combined. As the theories are mainly concerned with the general and overall effects of extraction they are likely to be more useful in the strategic problem of laying out roadways and faces and timing operations

[1] London : H.M. Stationery Office. Price 5s.

than in the tactical problem of using props and bars to support the workings, a conclusion which workers in metal mines will endorse.

United States Mineral Output

As is customary the United States Bureau of Mines has been prompt to issue a preliminary report on mineral production during the year just past. It will be recalled that the 1957 output at $18,300,000,000 was a record so that the 1958 figure of $16,400,000,000 now available reflects the general decline experienced in the year. This set-back is attributed by the Bureau to lower demand owing to economic conditions, to the termination, or slowing down, of Government stockpile purchases, withdrawals from stock, and to increased competition from overseas producers both in United States and world markets.

Looking at the general picture the report records that metals lost ground in 1958. While lower average prices were a factor in the overall decrease in value there were reductions in the volume of output of several important commodities. Among the metals, copper output declined approximately 10%, lead and zinc by 23%, iron ore was down 36%, and gold and silver production reached the lowest level since 1946. Mercury output, on the other hand, was marked by its eighth consecutive annual increase and uranium ore production also gained, being valued at $114,000,000 as compared with 1957's $78,000,000. The solid fuels (bituminous and anthracite coal) fell 20% in value. Since prices were only slightly below the 1957 level virtually all of the decrease in value reflects reductions in output. The total value of crude petroleum declined more than 10% and although average prices were slightly below the 1957 level nearly the entire reduction in value was due to decreased production. The total worth of non-metals other than fuels held practically constant. An increase of 9% in the value of cement production and 5% for phosphate rock offset declines in most other non-metals, prices for which remained relatively stable.

Reviewing the decreased consumption of lead and zinc in the year, due entirely to the decline in general industrial activity, which reductions in mine production were insufficient to offset, the report draws attention to the investigation of the matter by the United States Tariff Commission. This, it is stated, indicated that the domestic mining industry was being damaged by imports and that, as a result, the Commission recommended corrective action to the President. Congress considered but did not enact the legislation recommended by the Department of the Interior to give direct aid to domestic mine producers. However, to provide an appropriate and immediate remedy, the President did set import quotas, effective as from October 1 and allocated among exporting countries. The quotas were established at 80% of the average United States imports in 1953 to 1957. Note is also taken of the United Nations conference called to consider world surpluses, attention to which has already been drawn in these pages. As regards copper, mine production in the United States in 1958 was almost 10% lower than that in 1957 and throughout the first half of 1958 the copper industry was faced with the continuing problem of over-supply. However, the rise in demand created by improved industrial activity, coupled with curtailed output of the metal because of work stoppages and voluntary cutbacks, resulted in more favourable conditions during the second half of the year. In the case of aluminium, while there was reduced demand in 1958 the industry had enlarged production capacity by December to more than 2,100,000 annual tons—300,000 tons more than at the start of the year. Two new producers, Ormet Corporation and Harvey Aluminum, started operations and Reynolds Metals Company and the Kaiser Aluminum and Chemical Corporation each opened new potlines.

Note has been taken above of the expansion of the United States uranium industry. It may be observed that in 1958 uranium concentrate production was at a rate of about 14,000 tons a year, as compared with 10,000 tons in 1957 and 6,000 tons in 1956. Twenty uranium mills, with a total capacity of 16,200 tons of ore a day, were in production at the end of the year, compared with 14 mills, with an aggregate capacity of 10,000 tons, in 1957. Most of the increase in milling capacity was in the Ambrosia Lake area. At the same time the rare-metal industries continue their growth, mine shipments of their ores and concentrates in 1958 totalling about 1,000 short tons containing an estimated 625 tons of rare-earth oxides, witnessing their growing importance.

MONTHLY REVIEW

Introduction.—In spite of a seasonable rise in unemployment it would seem that business in general shows definite signs of improvement, although most base-metal prices show little change over the past month. Copper, however, has become firmer while tin prices advanced once it was learned that Russia had agreed to limit her exports of the metal to the free world to 13,500 tons for this year, a figure which compares with some 18,000 tons in 1958.

Transvaal.—The output of the Rand and O.F.S. mines for December is returned as 1,480,525 oz., making with 40,372 oz. from outside mines a total of 1,520,897 oz. The corresponding figures for January are 1,506,670 oz., 39,515 oz., and 1,546,185 oz. At the end of December there were 329,234 natives at work in the gold mines, a figure which had grown to 350,656 at the end of January.

With the report for the three months ended December 31 last shareholders of SPAARWATER GOLD MINING were informed that in view of the discovery of more encouraging reef widths and values in a haulage in the immediate neighbourhood of the western boundary of the mine the directors consider it desirable to continue the haulage, if possible, outside the company's existing lease area. Permission has been obtained to cross the boundary pillar, it is stated, and application has been made for a permit to prospect in the area lying to the west. The ore reserve fully developed at December 31 last, based on a pay limit calculated to conform approximately to existing conditions in respect of gold price and working costs is estimated at 263,000 tons averaging 5·8 dwt. per ton over a stoping width of 37·6 in.

With the recent dividend notice shareholders of TRANSVAAL GOLD MINING ESTATES were reminded that the advisability of placing the company in voluntary liquidation was under consideration during 1958. The ore reserve position and recent development results, however, indicate improved prospects for the Beta mine and in the circumstances the directors consider that it would be inappropriate to place the company in voluntary liquidation and they have therefore decided to distribute the funds surplus to requirements by way of a dividend at the rate of 1s. per share.

At the adjourned extraordinary general meeting of RAND LEASES (VOGELSTRUISFONTEIN) held on January 15 the resolution that the company's capital be reduced to £1,665,000 by a return of 9d. a share was approved. In his address to the meeting the chairman said that the payable ore in the company's claim area is being rapidly depleted and under present conditions of costs and the price of gold unlikely that the area below the Tertiary shaft workings will justify the considerable expense of exploration. The indications are, he said, that large-scale production can only be maintained for a further two or three years and that thereafter ore from reclamation in the upper levels of the mine will constitute the principal source of tonnage to the mill.

Speaking at the annual meeting of RUSTENBERG PLATINUM MINES held in Johannesburg earlier this month the chairman suggested that the current price for the metal is so low that if continued it will discourage the free flow of the metal to world markets. Of prospects for platinum in the present year he said that present indications were that sales will be at a higher level than they were in the year to August 31 last.

Orange Free State.—Speaking of recent development results at the annual meeting of FREE STATE GEDULD MINES held in Johannesburg on January 29 the chairman said that in the current year to January 23 the average development value had been 4,833 in.-dwt. This marked improvement was largely due to the influence of high values disclosed in the area south-west of No. 1 Shaft and these are due primarily to reef intersected in 45 Level on the upthrow side of the reverse fault south-west of the shaft and south of the " dome " area. The haulage and companion airway passed through the reverse fault and intersected the reef coming out of the foot-wall. An aggregate of 215 ft. was exposed in both ends at an average of 9,772 in.-dwt. before the reef was faulted into the hanging-wall by another section of the reverse fault. Development of the area beyond the reverse fault will be accomplished, the chairman said, by advancing 45 Level in a southerly direction in the foot-wall of the reef, but before stoping can start a haulage will have to be driven from the station presently being cut on 43 Level at No. 1 Shaft to provide the necessary connexion

for the stoping rises between 45 and 43 levels.

It has been announced that the No. 2 Sub-Vertical Shaft system at PRESIDENT BRAND GOLD MINING has been sunk to its final depth of 2,832 ft. below the collar on 46 Level, which is approximately 7,400 ft. below the surface. It is hoped to have the shaft fully commissioned in July next. At the same time preliminary work on the new No. 3 Shaft system has been completed. This system is to be sunk to approximately 5,000 ft. below surface and it is estimated that sinking will be completed towards the middle of 1960.

Shareholders of FREE STATE DEVELOPMENT AND INVESTMENT have been advised that, with a view to obtaining further information regarding the area, it has been decided to drill two bore-holes jointly with RAND MINES and WESTERN HOLDINGS on the western and eastern boundaries, respectively, of the block of farms immediately south of the Vaal River, over which the corporation holds the mineral rights. One hole will be sited on the western boundary of the farm Grootvadersbosch 470 at a point approximately 5,000 ft. south of the Vaal River. It will be drilled jointly with Western Holdings, while the other hole will be sited on the eastern boundary of the farm Doornkom Oost 447 at a point approximately 4,000 ft. south of the Vaal River. This will be drilled jointly with Rand Mines.

Northern Rhodesia.—The report of the RHODESIAN SELECTION TRUST and its main subsidiaries for the three months to December 31 last shows a profit of £949,000, subject to taxation. In the period MUFULIRA COPPER MINES produced 14,693 long tons of copper and CHIBULUMA MINES 2,947 tons. ROAN ANTELOPE COPPER MINES produced 13,465 tons of copper in the quarter.

Gold Coast.—With the recent dividend notice shareholders of the ASHANTI GOLDFIELDS CORPORATION were informed that a meeting is to be called for April 1 to consider the directors' recommendations for the increase of the authorized capital of the corporation and the issue of 3,121,294 shares of 4s. each by the capitalization of £624,278 16s. from the reserves. The issue would be at the rate of one new fully-paid share of 4s. for every three shares held.

GHANA MAIN REEF reports a profit of £71,612 for the year ended June 30 last, the accounts showing £144,149 for appropriation of which dividends equal to 7½% require £48,057. After allowing £18,425 for taxation a balance of £77,667 is carried forward. In the year 138,114 tons of ore was milled and 48,744 oz. of gold recovered. The available ore reserves at the end of the year are given as 278,513 tons, averaging 8·05 dwt. in value over 83·1 in.

Sierra Leone.—It was reported last month that BRITISH TITAN PRODUCTS is to surrender its rutile interests in Sierra Leone to the CONSOLIDATED ZINC CORPORATION. For some time, it is stated, British Titan Products has been operating in the Colony jointly with an American firm, COLUMBIA SOUTHERN CHEMICALS, INC., and discussions on the terms of future exploration and mining of rutile are being held. The Minister of Lands and Mines is expected to make a statement on the situation soon, the report says.

Nigeria.—JANTAR NIGERIA reports a profit of £28,321 for the year to September 30 last and a dividend equal to 3d. a stock unit has been declared, which will require £12,938. In the year 237 tons of tin concentrates and 194½ tons of columbite were produced, reserves at September 30 last being estimated as 1,176 tons of tin and 1,052 tons of columbite. The chairman in his statement accompanying the report and accounts says that despite limited demands for columbite the whole of the output for the year was sold, although at steadily deteriorating prices. Recently, he says, there has been an increase in demand which has enabled the company to sell the whole of the output for 1958–59 under contract at prices to be negotiated quarterly. In view of the permitted output allowed for the Basalt Lead being 5 tons per month, at which figure production from the operation was uneconomic, operations have been stopped until such time as restriction is ended.

During 1958 shareholders of the KADUNA SYNDICATE have been informed output has been limited to some 167 tons of concentrates. The comparable figure for KADUNA PROSPECTORS is 42 tons.

Tanganyika.—In the December quarter GEITA GOLD MINING milled 54,310 tons of ore and recovered 10,090 oz. of gold, the working profit for the period being £7,895.

URUWIRA MINERALS treated 79,099 metric tons of ore in the three months to December 31 last and produced 2,731 tons of mixed concentrates. The estimated loss for the quarter is given as £47,686.

Australia.—Last month the directors of PARINGA MINING AND EXPLORATION

announced that although the results of the preliminary field-work and geological investigations on the group of Milo Leases, situated in the Cloncurry district of Queensland, on which the company had an option were initially promising the results of the subsequent diamond-drilling programme did not, in their opinion, justify the expenditure of approximately £80,000 sterling which was required to exercise the option. The option agreement referred to has therefore now expired. The directors are investigating the possibility of collaborating with an existing Australian mining company, it is stated, in connexion with the leases situated in the Cloncurry–Mount Isa district which the company owns outright.

A preliminary statement put out by GOLD FIELDS AUSTRALIAN DEVELOPMENT shows that in 1958 the Mount Ida gold mine milled 35,659 short tons of ore and recovered 15,747 oz. of gold. The estimated " mining surplus " is given as £57,620.

The MOUNT LYELL MINING AND RAILWAY COMPANY treated 470,927 tons of ore in the December quarter and produced 10,196 tons of concentrates, estimated to contain 2,348 tons of copper. In the period 2,709 tons of blister copper was produced.

New Guinea.—In the three months to November 30 last BULOLO GOLD DREDGING dredged 1,614,900 cu. yd. of ground and recovered 5,716 oz. of gold. The profit for the half year to November 30 is given as $205,000.

Malaya.—Last month GOPENG CONSOLIDATED and KINTA TIN MINES announced that they had agreed jointly (subject to certain consents being obtained from the relevant Government Departments and Officials) to purchase for £150,000 the whole of the mining property and undertaking in Malaya of the SOCIÉTÉ FRANCAISE DES MINES D'ETAIN DE TEKKAH (known as French Tekkah). The two British companies work neighbouring tin-mining properties in Malaya and the French Tekkah property is adjacent to them. The benefits arising from this purchase, it is stated, include the acquisition of valuable water and electrical power supplies, some advantages of assessment under the International Tin Restriction Scheme, and land for dumping purposes.

The accounts of RAMBUTAN, LTD., for the year to June 30 last show a profit of £8,598 and a total of £26,400 available, of which £3,386 has been placed to reserve and £4,312 distributed as dividends equal to 1s. 6d. a share. The balance of £18,702 is carried forward. The output of tin concentrates for the year from 256,600 cu. yd. of ground treated was 152½ tons.

Mexico.—The report of SAN FRANCISCO MINES OF MEXICO for the year to September 30 last shows a loss of £207,959 which reduces the credit balance brought in to £246,420. In the year 22,797 metric tons of lead, 36,861 tons of zinc, and 2,746 tons of copper were sold, in addition to 92,535 kg. of silver and 211·4 kg. of gold. The report states that the tonnage milled during the year was 777,800 metric tons which was 18,300 tons less than in the previous year. The fall was a consequence of the breakdown in the North shaft hoist which prevented hoisting at the Frisco mine for 15 days in October–November, 1957; during the year the installation of the larger hoist purchased in 1956 was completed. The average grade of ore milled was approximately the same as in 1956–57 and although the 11% increase in wages, together with other economic benefits, granted in June, 1957, had to be borne for the entire year the company's operating costs show little change.

Dominican Republic.—It was reported earlier this month that the first shipment of bauxite from the Republic which was recently sent to the U.S.A. follows 17 years planning by the Aluminum Co. of America. Since 1941, when the preliminary researches were carried out, the company has, it is stated, invested $14,000,000 in the Republic. Regular shipments are to begin at the end of the current month and the company says it is very satisfied with the quality of the bauxite. It is estimated that over 1,000,000 tons will be extracted from quarries in Las Mercedes and Aceitillar and that the present deposits of bauxite could be worked at full capacity for at least 60 years.

Canada.—It was stated at the end of January by NORTHSPAN URANIUM MINES that as from February 1 the Spanish American property was to cease production. Northspan, it is pointed out, comprises three properties—Lacnor, Panel, and Spanish American—which together represent a capital investment of over $100,000,000, imposing onerous financial obligations. During 1958 the company attained the rates of production specified in Northspan's contract with Eldorado. The first two of the three properties to come into production, Lacnor and Panel, in fact exceeded anticipated outputs

with the result that during the last few months of 1958 Northspan's shipments of uranium oxide substantially exceeded the contract rate. Northspan sought and obtained the approval of ELDORADO MINING AND REFINING to ship at accelerated monthly rates during the last six months of 1958, but Eldorado's permission contained the reservation that it might be necessary to impose a cutback upon Northspan during the first half of 1959 to offset the overshipments during the last half of 1958. The cutback has now been imposed and since Lacnor and Panel can together produce the reduced allotment the Spanish-American output will not be needed. It is anticipated that the normal contract rate of shipments will be resumed in July and hoped that with further steps now being taken the Lacnor and Panel properties will then be in a position to fulfil Northspan's contract commitments. Under this arrangement labour, management, and the citizens of the Elliot Lake area will be able, it is suggested, to contemplate capacity operation of these two properties for the balance of the contract.

It has been reported that LUNDBERG EXPLORATION is joining with the WENNER-GREN BRITISH COLUMBIA DEVELOPMENT COMPANY to complete a series of geophysical surveys over 128,000 sq. miles in the north of the Province. A drilling programme has been planned to follow the surveys.

American-South African Investment Co.—Earlier this month it was announced that at the end of 1958 the American-South African Investment Company had net assets of $36,058,636, equivalent to $30·05 per share. In his letter to shareholders, Mr. Charles W. Engelhard, the chairman, stated that, of the year-end net assets approximately 80% was accounted for by investment in South African gold-mining industry, about 6% by investments in coal-mining and other South African industries, and the balance of some 14% by South African treasury bills, cash, gold bullion, and net amounts receivable. The company announced that since the year end about $1,200,000 of cash had been invested in additional shares, mainly in the gold-mining industry.

British South Africa Co.—With the recent dividend notice shareholders of the British South Africa Company were informed that the net profit for the year ended September 30, 1958, was £4,363,217 (previous year £4,830,496).

DIVIDENDS DECLARED

* Interim † Final

(Less Tax unless otherwise stated.)

Aluminium, Ltd.—Quarterly 17½ cents (U.S.), payable Mar. 5.
***Amalgamated Metal Corporation.**—3%, payable Feb. 26.
***Amalgamated Tin Mines of Nigeria.**—6%.
†Anglo American Investment Trust.—10s. and 2s. 6d. bonus, payable Mar. 6.
***Anglo-French Posphate.**—10%.
***Anglo-Huronian.**—25 cents (Canad.), payable Feb. 18.
†Ashanti Goldfields Corporation.—1s. and 6d. bonus.
***Attock Oil Co.**—1s. free of tax, payable Mar. 3.
†Bibiani (1927).—2·4d.
†Borax (Holdings).—3½d.
British South Africa Co.—†3s. 3d. and *9d., payable Mar. 28.
†British Burmah Petroleum.—2%.
†English China Clays.—5¼%, free of tax.
†Fanti Consolidated.—10% and 5% bonus.
***Geevor Tin Mines.**—6d., payable Mar. 6.
Ghana Main Reef.—†2½% and *7½% and 2½% bonus, payable Feb. 27.
International Nickel Co. of Canada.—Quarterly 65 cents (U.S.), payable Mar. 20.
†Jantar Nigeria Co.—3d., payable Feb. 5.
***Kaduna Prospectors.**—2d., payable Feb. 6.
***Kaduna Syndicate.**—2d., payable Feb. 6.
***Kamunting Tin Dredging.**—4½d., payable Mar. 3.
***Lydenburg Gold Farms.**—1d.
***Mount Morgan.**—9d. Aust., payable Mar. 31.
***New Witwatersrand Gold Exploration Co.**—1½d.
†Orange Free State Investment Trust.—2s. 6d., payable Mar. 6.
***Southern Kinta Consolidated.**—20%, payable Mar. 6.
†Transvaal Gold Mining Estates.—1s., payable Mar. 5.
†Vereeniging Estates.—5s., payable Mar. 19.
†West Rand Investment Trust.—2s. 3d., payable Mar. 7.
†Western Mining Corporation.—6d. Aust., payable Feb. 27.
***Zaaiplaats Tin Mining.**—25%, payable Mar. 7.

METAL PRICES

Feb. 10.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	180	0	0
Antimony (Eng. 99%)	190	0	0
Chromium (98%–99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	19	10	0
Silver		6	4⅞
Gold	12	9	7½
Wolfram (U.K.)		—	
(World)	4	8	0

Tin, Copper, Lead, Zinc — See Table, p. 112.

Iron by Direct Reduction

J. Grindrod

A description of the Strategic-Udy process developed in America

Combining the use of a rotary kiln and an electric furnace smelter a new method of direct iron reduction, known as the Strategic-Udy process, has been developed recently in the United States by Strategic-Udy Metallurgical and Chemical Processes, Ltd., a subsidiary of the Strategic Materials Corporation. This company has had a working agreement with Koppers Company, Inc., since October, 1957, covering the application of metallurgical processes under development by it and joint effort has been expended on the selective reduction of complex iron ores and the recovery of ferro alloys, as well as on the electric smelting of standard " shipping grade " iron ores.

Whereas in other processes which use the electric furnace the submerged-arc method of charging is generally used, in the Strategic-Udy process a " floating charge " technique is used instead. By this method the charge material slides down the sides of the furnace substantially in accordance with its angle of repose and the partly pre-reduced and preheated feed material is thus charged directly to the reaction zone at the electrodes, making it possible to control reaction with comparative ease. Because of the close control of the reaction zone and the method of charging certain unique process advantages accrue.

In the direct-fired rotary kiln used by the Strategic-Udy process for partial pre-reduction of iron ore a substantial portion of the heat required is supplied by burning the carbon monoxide gas produced from the reduction reactions of the electric furnace. During the operation a mixture of iron ore, flux, and carbonaceous reductant is continuously fed to the kiln, the ore being heated, calcined, and pre-reduced while the limestone or dolomite flux is calcined and combined chemically with the ore. The maximum temperature of the free-flowing discharge from the kiln is controlled within the range of 1,800° and 2,300° F., varying for different ores. Beyond this temperature the

Fig. 1.—Prototype Plant at Niagara Falls.

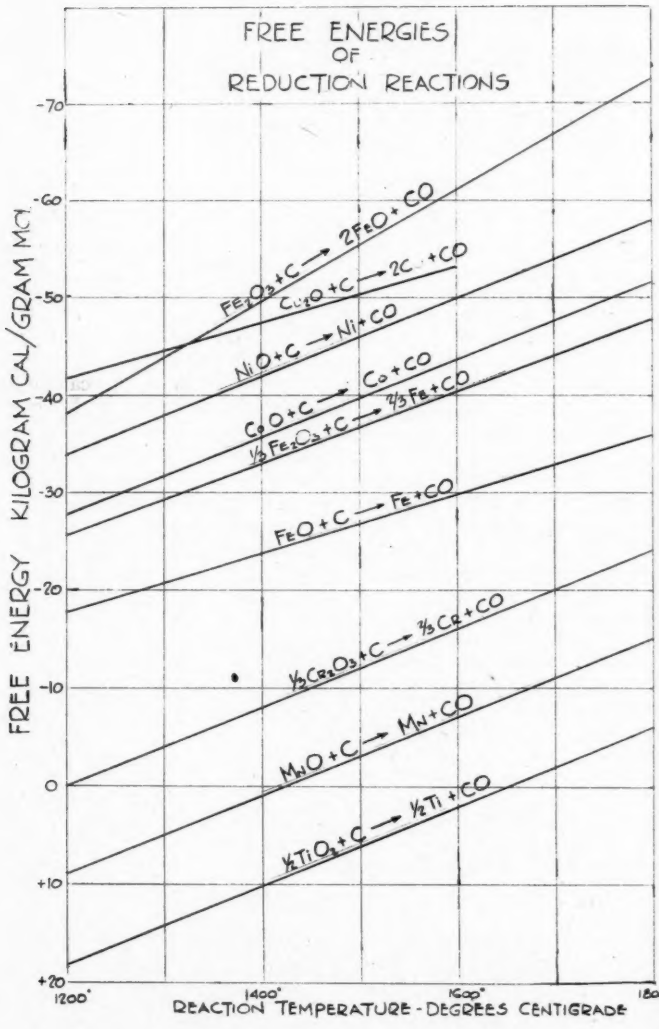


Fig. 2.—Curves of Free Energy-Temperature Relationships.

hot charge material starts to cake and adhere to the walls of the kiln, forming a ring. Sufficient coal is added to the kiln to accomplish the two-step reduction that is required. That part of the coal not utilized in the pre-reduction or burnt in the kiln is " coked " in the kiln and passes out with the pre-reduced material for use as a pre-heated reductant in the electric smelting step.

To save thermal and electrical energy the hot pre-reduced ore from the kiln is charged directly to the smelting zone of the electric furnace through insulated feed-control bins and controlled feeders. Within the furnace an open-bath technique is employed with the electrodes from ½ in. above the molten slag to 3 in. submerged in the slag, depending upon the needs of the particular operation. Since the charge material enters the periphery of the furnace and forms its own angle of repose the space above the electrodes is open and offers no restriction to the flow of fast-liberated reaction carbon monoxide gas. The molten bath furnishes a constant electrical resistance and permits high and uniform

power inputs. Fines may be charged without interfering with the operation.

With this process it is possible to vary the carbon content from pig iron at 3·5% to "semi steel" at 0·2%. Accurate control of the slag composition permits selective smelting to remove contaminating elements—such as, titanium, manganese, phosphorus, chromium, and nickel—and also permits high recovery of iron. If present in sufficient concentration the contaminating elements can be recovered for credit. Where exact carbon control of the iron is required finishing additions of reductant can be introduced in the smelting furnace or carbon adjustments made by the addition of iron ore. Iron and slag are tapped intermittently and handled in the conventional manner.

Since the reduction process is capable of accurate control unwanted materials can readily be separated from the iron. A study of the free energies and equilibria of the various reduction reactions will establish the oxides that can be expected to stay in the slag. Oxides of chromium, manganese, and titanium are examples of materials that can be left in the slag. Oxides of copper, cobalt, and nickel are more readily reduced than iron and a selective step would be required if the iron ores contained such materials.

Those reactions which have the higher negative values in the accompanying graph of free energy-temperature relationships (Fig. 2) are more likely to proceed to completion than those which have lower negative, or positive, free energies of formation. Thus, by control of the degree of reduction through controlled use of carbon, it is possible to practise selective reduction with an ore. In this respect the process differs from a blast-furnace, where the necessary addition of an excess of reductant makes the selective reduction process impractical.

The prototype plant used by Strategic-Udy Metallurgical and Chemical Processes, Ltd., at Niagara Falls, Ontario, to demonstrate the process consists of three 1,000-kVA "Volta" (modified in design) three-phase electric smelting furnaces; one 6-ft. diameter by 80-ft. long gas or oil-fired rotary kiln, with dust collector and fan; crushing, drying, conveying, and storage bin equipment; two 15-ton bridge cranes with 5-ton capacity auxiliary hoist; ladle, moulds, chills, etc., and complete laboratory equipment for quality control and chemical analyses.

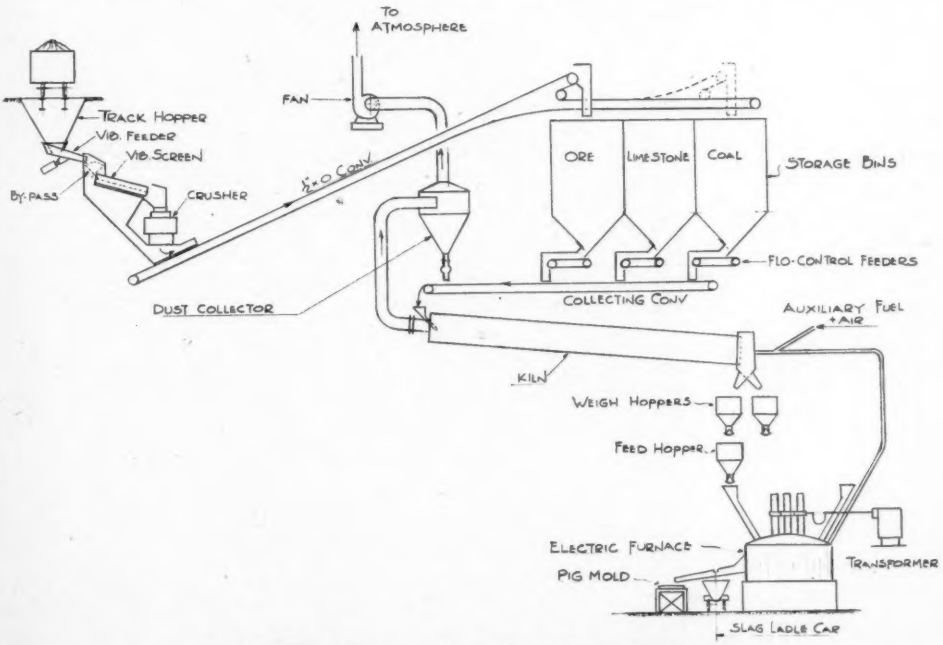


Fig. 3.—Flow Diagram of the Direct-Reduction Process.

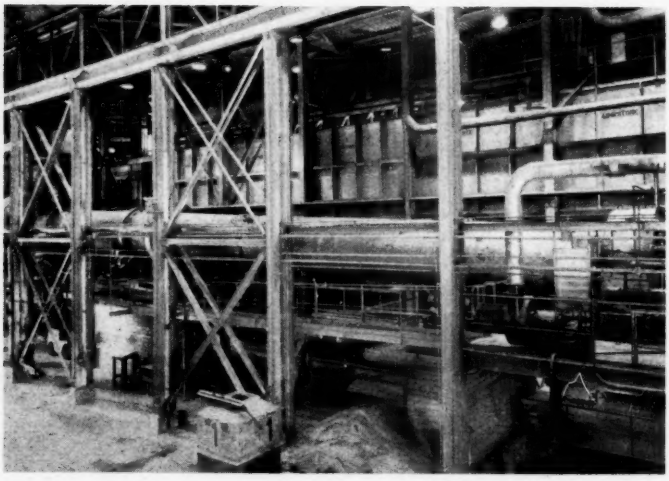


Fig. 4.— The Rotary Kiln.

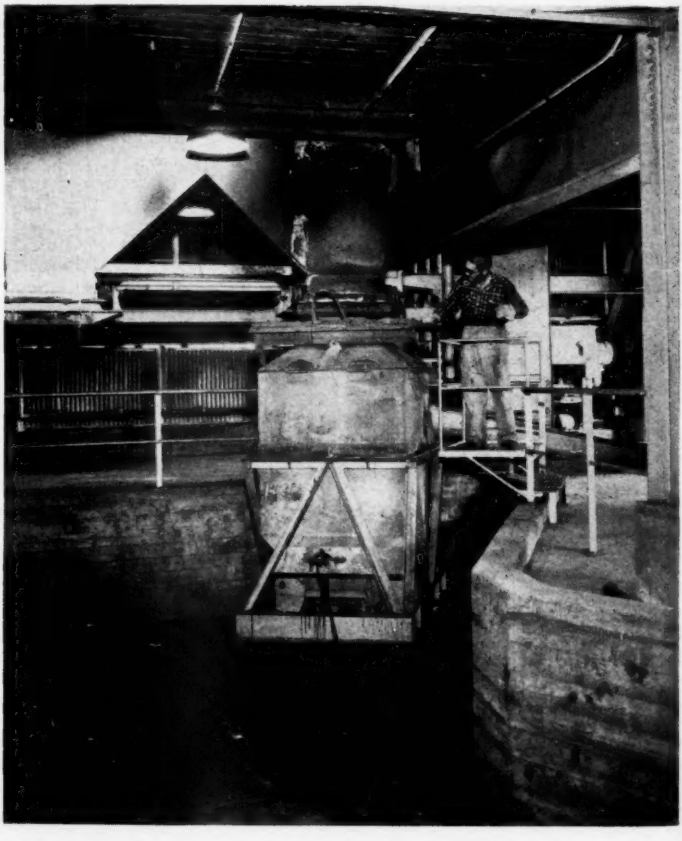


Fig. 5.— Kiln Product Fed at High Temperature to Feeder.

Fig. 6.—Hot Sinter Being Fed to Reduction Furnace.

Rough calculations have been made to determine the material and energy requirements to produce iron ore by the Strategic-Udy process using typical shipping iron ore and based on a throughput of 300 tons per day or 105,000 tons a year. Kiln pre-reduction is taken at 37% of Fe requirements reduced to metal, the rest to FeO, although this amount of pre-reduction has been exceeded at Niagara Falls. Sufficient coal is added to the kiln to reduce all the iron oxide.

According to these calculations the requirements were as shown in Table 1.

Table 1

Materials		
Iron ore	1·77	tons/ton pig-iron
Limestone	0·50	*do.*
Coal	0·43	*do.*

Heat Duty of Kiln.—Total net heat requirements = 511,600,000 B.Th.U./day at 70% utilization. (This includes loss from radiation and convection, in waste gases, the heat from the combustion of the volatile matter in the coal being neglected.) The fuel requirements are :—

$$\frac{511{,}600{,}000}{\cdot 70} = 730{,}900{,}000 \text{ B.Th.U./day}$$

There is an excess of furnace gas over that required by the kiln and no auxiliary heat is needed.

Table 2

ELECTRIC FURNACE

Furnace burden.	*Tons/day.*	%
Fe	110·00	21·4
FeO	259·65	50·5
SiO_2	46·35	9·03
Al_2O_3	12·64	2·46
CaO	76·27	14·85
MgO	0·21	0·04
P_2O_5	1·02	0·20
MnO	7·67	1·50
	513·81	100·00

CO produced	101 tons/day
C.F. of CO produced	2,730,000 C.F.D.
Gas per ton pig iron	9,100 C.F. gas/ton pig-iron
B.Th.U. heating value	877,000,000 B.Th.U./day
Available heat at 85%	746,000,000 B.Th.U./day
Electrode consumption	25 lb. per ton of metal

Table 3

THERMAL REQUIREMENTS FOR ELECTRIC FURNACES

Duty.	*B.Th.U./day.*
Reduction of iron of FeO . .	486,000,000
Reduction of silicon of SiO_2 . .	11,700,000
Reduction of phosphorus . .	5,900,000
Heat to raise hot charge 1,000° F. .	323,400,000
	827,000,000

The kWh per ton of pig iron is 1,010. Using typically purchased ore at a Great Lakes Port, purchased coal, purchased oil and power, and manufacturing costs per ton of pig iron have worked out as follows: At 300 ton/day, $43·71; at 600 ton/day, $43·21, and at 1,200 ton/day, $42·71. A captive mine operation would result in substantially lower costs since the cost of the ore represents a major cost item. The cost of power and the cost of fuel, whether oil or natural gas, would also have an effect on the total manufacturing cost which, for a 600-ton/day plant could, it is said, vary between $30 and $50 per ton of pig iron.

The capital cost of a 600-ton/day plant employing the Strategic-Udy process is estimated at approximately $50 per ton of annual capacity.

Other major advantages claimed for the process are: (1) Most ores may be used, including flue dust, without special preparation such as agglomerating, sintering, briquetting, or nodulizing; (2) complex ores, now of little value, may be used (This feature makes available the tremendous deposits of titaniferous magnetites in North America and elsewhere for direct use as iron ores.); (3) the process permits latitude in selecting a reductant and fuel, since coal, peat, lignite, or coke may be used; (4) control of carbon content is possible; (5) the process will make low-carbon hot metal available, thus shortening the time of making a heat of steel in the electric finishing furnace (If installed in circuit with an existing open hearth the process could reduce the time of open-hearth heats and the amount of oxygen and ores necessary to remove the carbon to the desired level; similarly, hot iron of regulated carbon content could be supplied for Bessemer or oxygen-blowing processes.); (6) the process could be adapted to cold metal shops where molten iron would be a great advantage.

In September last the economic performance of integrated steel plants employing the Strategic-Udy direct iron reduction process was guaranteed by Strategic Materials Corporation and Koppers Company, Inc., this guarantee depending only on the availability of reasonably-priced electric power and the advantageous location of raw materials. This willingness to certify the economic performance of the process is based largely on results obtained in tests at Niagara Falls.

Coinciding with this announcement Dr. Marvin Udy, inventor of the process, and Mr. R. A. Blackburn, Koppers representative, gave a technical paper before the annual meeting of the Association of Iron and Steel Engineers at Cleveland, Ohio, on September 25, describing the process and presenting technical and financial data on the prototype plant. The writer is indebted to the Association of Iron and Steel Engineers for permission to use some of the information contained in this paper and to Strategic-Udy Processes, Inc., for making this available.

Mond Nickel Fellowships

Applications are invited for the award of Mond Nickel Fellowships for 1959. The main object of these Fellowships, it will be recalled, is to enable selected applicants of British nationality and educated to university degree or equivalent standard to obtain additional training and wider experience in industrial establishments at home or abroad so that, if they are subsequently employed in executive or administrative positions in the British metallurgical industries, they will be better qualified to appreciate the technological significance of research and to apply its results. In addition they may be used to assist those with metallurgical qualifications to obtain additional training or to provide the means of attracting persons with other scientific qualifications into the metallurgical industry. There are no age limits, although awards will seldom be made to persons over 35 years of age.

Each Fellowship will occupy one full working year and it is hoped to award five Fellowships each year of an approximate value of £900 to £1,200 each. Applicants are required to define the programme of training they wish to pursue, as well as particulars of their education, qualifications, and previous career. Full particulars and forms of application can be obtained from the Secretary, Mond Nickel Fellowships Committee, 4, Grosvenor Gardens, London, S.W. 1. Completed application forms are required to reach the Secretary of the Committee not later than June 1, 1959.

An Asbestos Mining Achievement

W. E. Sinclair, M.I.M.M.

A note on Lake Asbestos of Quebec, Ltd., now actively producing

Introduction

Last summer in Canada a major asbestos proposition joined the ranks of the existing eleven producing mines in the main asbestos field in Quebec Eastern Townships. The present output from these mines is nearly 1,000,000 tons annually (actually 989,948 tons in 1956) and that total will be increased substantially by the treatment of some 5,000 tons of ore daily by the Lake Asbestos of Quebec, Ltd., a newcomer whose immense and varied development undertaking has just been completed after nearly three years of round the clock operations.[1]

The position of the new mine in relation to Thetford Mines and Asbestos, the main centres of this great field, is shown in Fig. 1. The Lake Asbestos area is located in the common geological formation known locally as the "Serpentine Belt," in which most of the existing chrysotile mines are contained. This mineralized belt, situated in the rocks of the Appalacian Region, stretches for about 150 miles in a north-westerly by south-easterly direction through country made up of low wooded hills and a fair profusion of lakes in the valleys. It is hardly surprising, in the circumstances, that the Lake Asbestos deposit underlies a portion of Black Lake, at a depth varying from 75 ft. to 200 ft; indeed, it is surprising that much more of the asbestos-bearing serpentine rocks are not covered by water.

Development Plans

After some preliminary investigations before 1952 the American Smelting and Refining Company took an active interest in the proposition and after close examination of the position decided against the original proposal that the deposit might be worked wholly by underground methods. Instead, they decided to attack the ore-body initially by open-cast mining after draining that part of the lake covering the ore.

[1] Reference to the official opening of the property on October 16 last was made by our Toronto correspondent in the January issue.

As might be expected the work necessary to do this entailed much more than simply draining part of the lake; indeed it involved the execution of a variety of earthwork jobs, which together amounted to a project of such magnitude that it would be considered unique in itself had a somewhat similar undertaking not already been carried out in Canada.[1]

Before serious consideration could be given to the projected scheme, and all the detailed plans of attack drawn up, underground development amounting to nearly 20,000 ft. of driving in the ore-body under the lake was done to prove the extent and tenor of the ore. In addition, as a check, about 100,000 ft. of exploratory drilling was undertaken and approximately half the core recovered was milled to determine recovery values. Bulk samples were previously milled and tested from most of the underground drives. Two payable ore-bodies amounting to some 40,000 tons were delimitated by this work. By mining and milling 5,000 tons of ore daily it was estimated that the proved reserves will provide a working "life" of 25 to 30 years.

Draining Black Lake

Having this substantial evidence to support the ambitious undertaking plans to expose the ore-bodies were put in hand immediately. Before draining operations were actually commenced provision had to be made to isolate that portion of the lake covering the ore-bodies by the construction of dams. Once this was done a suction-cutter dredge was installed to remove all silt and loose rubble simultaneously with the pumping of water. Booster pumps assisted in this work by forcing the material from the dredge on to the disposal dams. At the same time electric shovels were employed stripping overburden round the edge of the lake shore as the water level receded. Auxiliary work included in the plans consisted of the diversion of the Becancour River on the east side

[1] Steep Rock Iron Mines, Atikokan, Ontario.

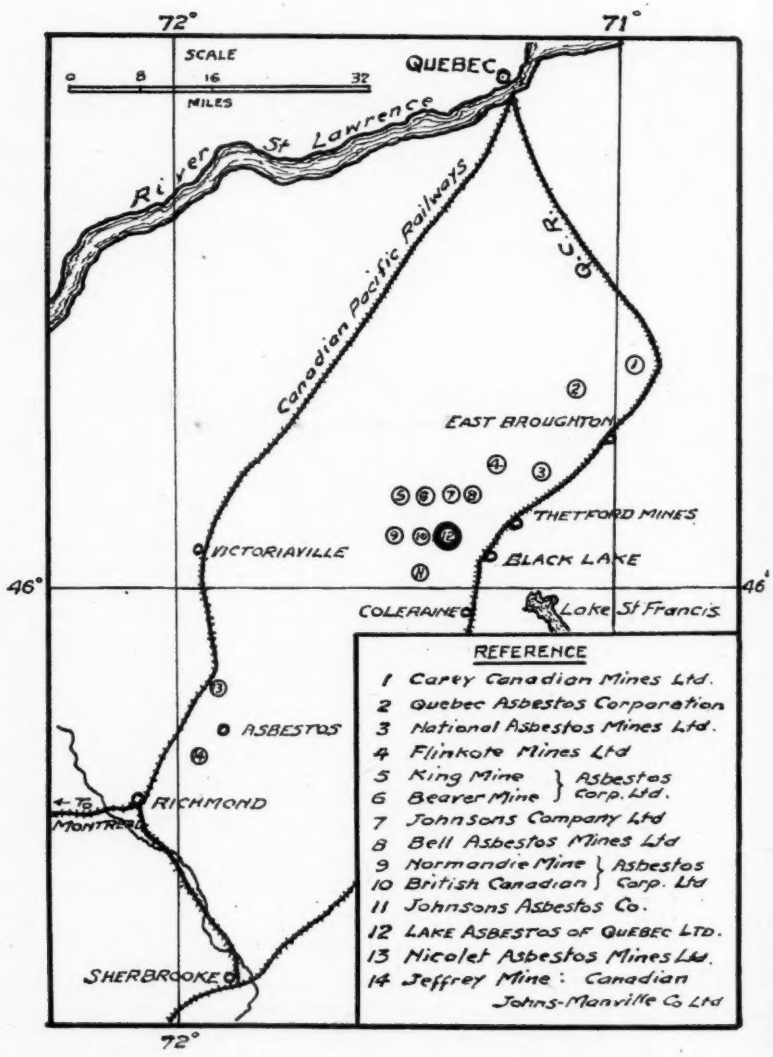


Fig. 1.—Principal Mines in the Eastern Townships of Quebec.

of the lake and the widening of the river bed over a considerable distance.

Two main dams were built, one to cut off the northern part of Black Lake and another to control the flow from Trout Lake. Similarly several diversion ditches and small dams were made to regulate the flow of water and to cover the dredging area from all inflowing water.

Two disposal dams were provided to hold the clay, sand, and loose stones removed from the lake by dredging. The quantity to be held was estimated at about 40,000,000 cu. yd. delivered at the rate of 100 cu. ft. per sec. through 30-in. diameter pipes. This inflow was handled in the main dam by hydraulic methods in order to control the disposal of the material evenly along the length of the dam, which was 4,700 ft. long by 70 ft. high.

The ramifications of the different operations and the general layout of the work are shown in the map, Fig. 2. From this the magnitude of the undertaking will be more clearly

followed if consideration is given to the principal items of plant and equipment continously employed on the various jobs.

On Lake: Drainage and silt removal.

Dredge: 30-in. suction with cable reel barge.

Derrick barge: 50-ton capacity.

Two work boats with ice breakers.

One monitor barge with 2,000–3,000 g.p.m. diesel-driven pump.

One monitor barge with 1,000–5,000 g.p.m. electrically-driven pump.

On Shore: Stripping overburden, ditching, and dam building.

Two booster pump stations and one service shop.

Two 4-cu. yd. electric shovels.

One $4\frac{1}{2}$-cu. yd. electric shovel.

One $2\frac{1}{2}$-cu. yd. diesel shovel.

Four crawler tractors.

18 diesel trucks, 22-ton capacity.

Two motor graders.

Six self-propelled rock-drills.

Three semi-portable 150-h.p. electric air-compressors.

One portable 500-h.p. diesel air-compressor.

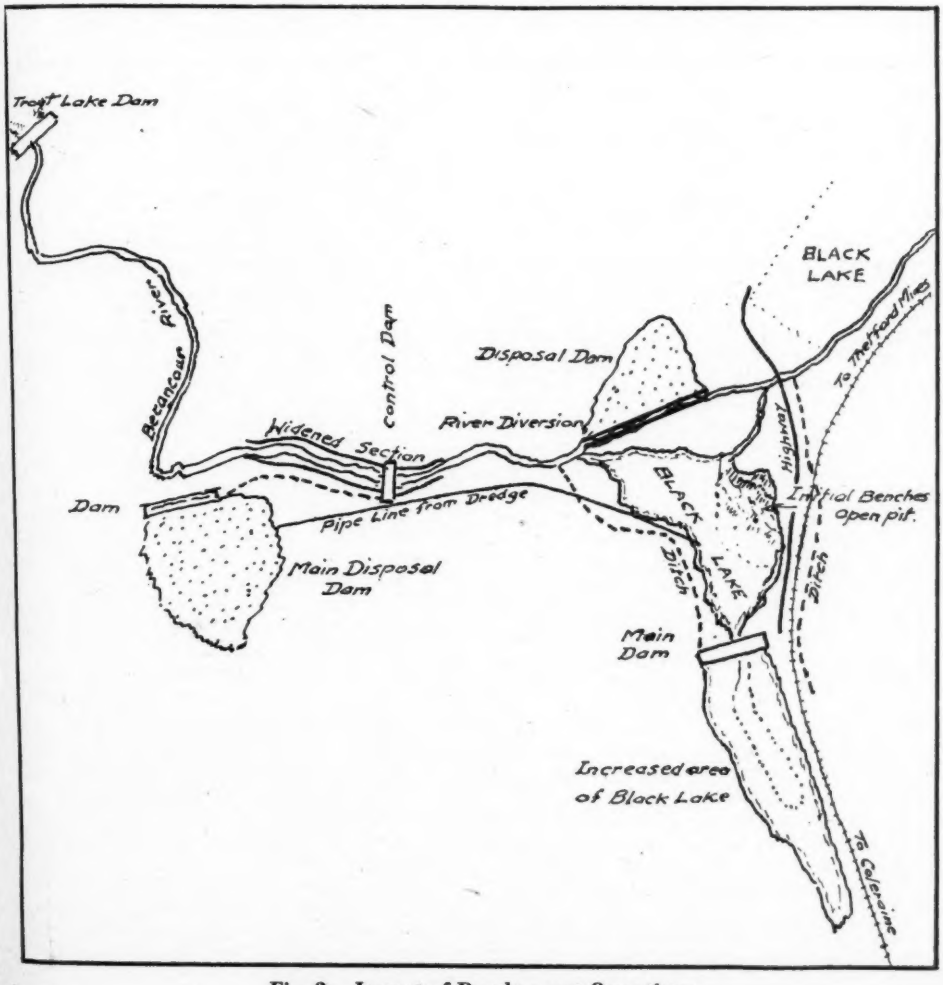


Fig. 2.—Layout of Development Operations.

Plant Construction

While these varied and important operations were being carried out in correct sequence to fit in with the overall plans, construction work on the mill, workshops, and offices was pursued simultaneously so that all production plant would be ready to start up when the first benches cut into the ore. This timing was so well arranged that when these notes were written the electric shovels were already cutting the initial benches and ore is being delivered to the crusher station. While the dredge moved northwards the shovels were cutting the 40-ft. high benches in the top section of No. 1 ore-body. The benches were being drilled by 4-in. and 6-in. diameter self-propelled machines and the broken ore after blasting loaded by electric shovels on to the diesel trucks for delivery to the crushers.

Haulage roads out of the pit are maintained at a maximum grade of 6%.

Production Operations

Ore delivered to the crusher plant is subjected to primary crushing through a 48 in. by 60 in. jaw-crusher set at 6½ in. Secondary crushing is executed by a gyratory crusher set at 1¾ in. operating in closed circuit. Crushed ore is delivered by conveyor-belt to a wet rock storage pile (capacity 100,000 tons) and drying plant. After drying the ore is conveyed to dry rock storage bins and thence transported underground by conveyor-belt to the mill. Blending of the ore to maintain a regular mill grade is effected in the dry rock storage section.

The mill proper is contained in a 14-storey building that houses the full conventional plant and equipment to treat 5,000 tons of ore daily. As the ore is delivered to the mill initial treatment consists of tertiary crushing in gyratory crushers followed by finer comminution in air-swept Hazemag crushers, air-swept Torreys, and fiberizers. The final cleaning and grading of the fibre recovered in cyclones by aspiration is done on shaking and gyratory screens, standard graders, and classifiers.

An important section of the mill (the top floor) incorporates fans which draw the dust from the exhaust air through dust filters.

Finished fibre is fed to mixing bins and taken from there to pressure packing units on the ground floor, where the asbestos is packed in various grades into jute and paper bags or containers, depending on whether the product is required for local or export consumption.

Tailings from continuous treatment throughout all sections of the mill is delivered to a central waste dump by an overhead conveyor system. The position of this unit is shown in the sketch. The main highway, also indicated in sketch, lying to the north of the pit and plant site, was one of the first essential constructional jobs since the original position of the road interfered with the whole development project and therefore had to be moved to the new site.

The successful completion of this undertaking and the establishment of another major chrysotile producer without serious hitch, despite some unusual problems, is a marked tribute to all those concerned with the project.

The cost of the whole job will amount to over $32,000,000 In addition, construction work on milling plant and equipment will cost nearly $10,000,000. The return from this capital outlay based on the proved reserves in the two ore-bodies and the proposed scale of working is estimated at a recovery of 100,000 tons of high-grade chrysotile asbestos annually.

Mining School in Jos

The Government of Nigeria, it has recently been announced, has opened a mining school in Jos, centre of the tin-mining industry. The new establishment, which contains a mineral-dressing plant, will, it is hoped, serve three purposes. It is intended first to give instruction to those already engaged in the industry and to Mines Department technical officers, who will take the same course as part of their training. Secondly the school is giving mines operators, particularly the smaller ones who have inadequate machinery, the facility of using the mill for dressing their ore. Finally the school is to carry out experiments on new ore to find out the best way of bringing it up to commercial grade.

The school buildings and machinery cost £23,000, it is stated.

Particular emphasis is to be laid, the Government announcement says, on training in mineral dressing. Experience in this kind of work is considered an important part of managerial training.

Compressed-Air Systems

Leo Walter, M.Inst.F.

The author discusses the importance of maintaining efficiency

Introduction

Much has been said concerning the increased productivity which is frequently possible by the use of pneumatic equipment in mining. The economic benefits to be derived from the use of air-operated equipment in general may be assessed more accurately when considered in relation to the operational cost of the entire compressed-air system. This has to be compared with the use of electricity which is steadily gaining ground.

In order to determine an enlargement and modernization of an existing compressed-air system the problem arises what the present air-compressor capacity and actual load are. In addition an accurate estimate of the amount of compressed air consumed by each piece of additional air-operated equipment is important. A pattern of probable peak and valley demands upon the total compressor plant, comprising existing and new compressor units, will show the way to choose the size and sometimes the design of new compressor units. An over-estimate of new capacity can result

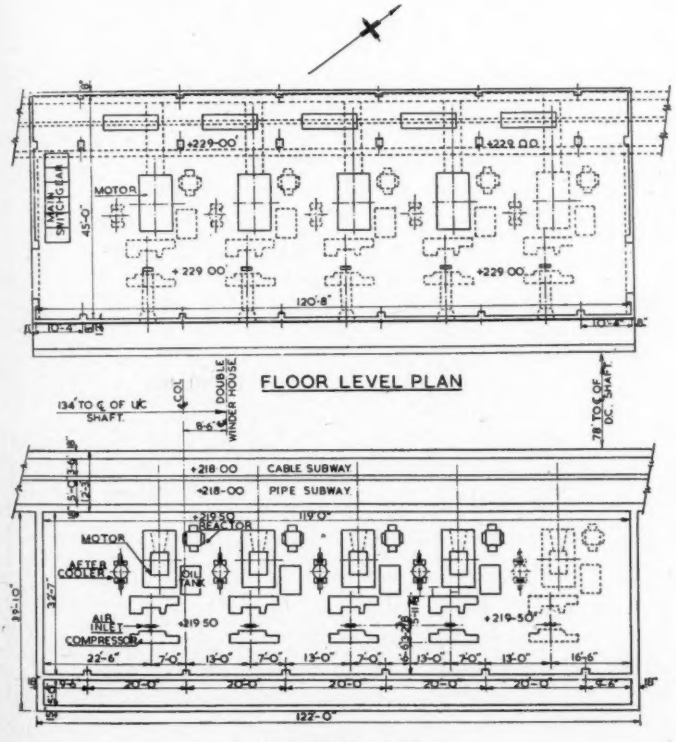


Fig. 1.—Mine Compressor Plant Layout.

(*National Coal Board.*)

in a capital investment larger than necessary ; an underestimate would be fatal.

There are several ways of making an analysis regarding the required plant capacity. With the total figures before him on the estimated amount of compressed air required for future daily operations, including peak demands, the planning engineer is ready to go deeper into details of the compressor plants which will best meet his requirements. A well-installed air-compressor plant of the right type suitable for the work performed and taking into account all local necessities is one of the most important steps in assuring efficient and economical operation at the points of use.

The plant itself is, however, not the whole story (Fig. 1). In spite of the great progress made in compressor design there seems to be no wholly satisfactory underground air-compressor plant available taking into account the requirements of high-speed underground development and future stowage. A surface plant is certainly advisable where it is desirable to install any necessary shaft mains during shaft equipping. For example, the compressor house may be located between mine car houses and adjacent to the cable and pipe section of a main subway. A recent plant consists of five compressors, having an estimated total force-air capacity of 20,000 to 24,000 cu. ft./min., as a provisional figure. In view of the manner in which the units will have to operate with a low load factor of the plant and widely varying requirements, comparatively moderate units of 4,000 and 6,000 cu. ft./min. were chosen.

Investigations carried out by the prospective user and by makers and other large users of compressors disclosed the following about reciprocating *versus* rotating machines :—

Advantages claimed for reciprocating compressors are, amongst others : Lower initial cost ; higher efficiency with consequent lower cost per power unit ; easy maintenance of modern types with good access to valves, etc.

In favour of turbo-machines seem to be : Suitability for larger capacities (over 5,000 cu. ft./min.) ; requirement of lighter foundations ; less air pulsations ; small vibrations and, most important, no air contamination from lubricating oil.

To these advantages of centrifugal compressors can be added : Lower cooling water demand ; lower power consumption on no load ; better controllability ; quiet operation, and ease of supervision. Improved water-cooling systems, of course, benefit both machine types.

Protecting Equipment

Many a planning engineer who has to consider adding capacity to his compressor plant may find the machine itself adequate, but a survey of the existing system may disclose sources of trouble in air distribution. Undersized piping, air leaks, or both, may cause trouble rather than inadequate compressor capacity. Wastage of compressed air may occur unnoticed for any length of time unless checking tests are regularly performed. Continuous use of rate-of-flow meters will, of course, disclose abnormal air consumption, and so will signal or alarm equipment. The modern air-compressor instrument panel (Fig. 1) will not only measure various factors but will also protect the compressor plant. A typical Teddington instrument panel may protect the compressor against the following hazards : Excessive L.P. discharge temperature ; excessive H.P. discharge temperature ; loss of lubricating oil pressure, and loss of coolant flow (if an external flow switch is fitted).

The equipment does this by interrupting the intrinsically-safe pilot circuit of the gate-end switchgear or by tripping the no-volt coil of the motor starter. It can stop the compressor if the temperature rises above or the lubricating-oil pressure falls below a pre-set danger level or if the coolant flow falls below a safe minimum. Advance warning of rising temperature is given by an alarm bell and an indicating unit fitted with a series of pilot lamps enables the cause of warning or shut-down to be distinguished immediately.

Gauges may be provided on the panel front for : L.P. discharge temperature ; H.P. discharge temperature ; L.P. inlet temperature ; H.P. inlet temperature ; lubricating-oil pressure ; lubricating-oil temperature ; inter-stage pressure, or discharge pressure.

The complete set of equipment as described is N.C.B. approved and covered by Certificate Nos. FLP Group I—3444 Group II—3445 and M. of P.

The set of protection equipment consists of (Figs. 2 and 2*a*) :—

(*a*) The protection panel containing the indicating gauges and the protection switches. This operates as an intrinsically-safe unit fed by an intrinsically-safe supply from the indicator unit.

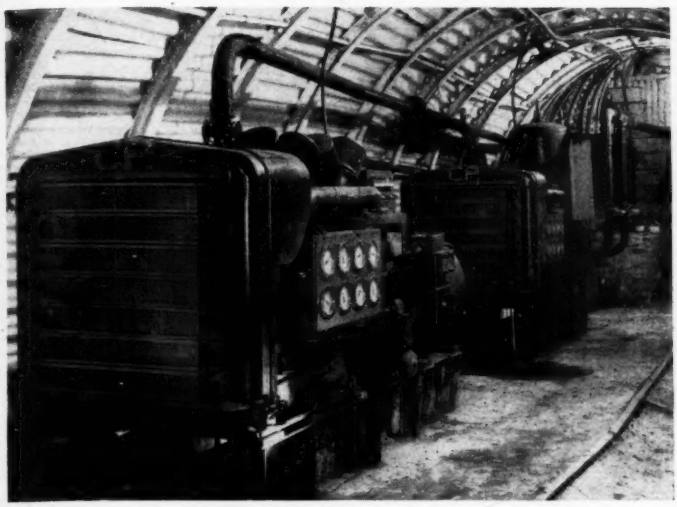


Fig. 2.— Compressors with Control Instrument Panels.

(Teddington Industrial Equipment Co.)

(*b*) The flameproof indicator unit which contains the a.c./d.c. relays for operating the fault indicating lamps and the pilot circuit of the motor-switchgear. This unit also embodies two step-down transformers, one for the intrinsically-safe supply to the panel and for the alarm bell, the other for supplying the indicator lamps.

(*c*) The alarm bell, an intrinsically-safe component fed by the supply from the indicating unit.

(*d*) A flameproof rotary switch which incorporates two mechanical time delays to hold-in the pilot circuit of the motor switchgear during the starting sequence. One time delayed switch "Z" enables normal oil pressure to be established before the protection circuit comes into operation and the other "X" provides protection against an accidental start after a power failure.

Once the main starter is energized the current supplied through the latter circuit will be sufficient to hold the starter in but not sufficient to pull it in the event of a

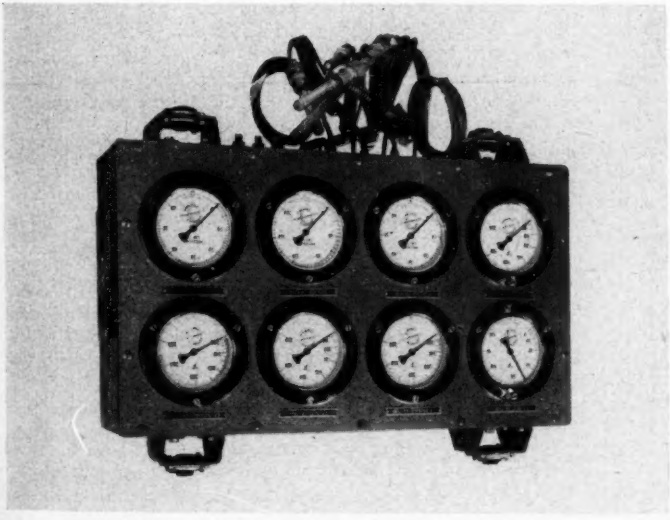


Fig. 2a.— Closer View of Instrument Panel.

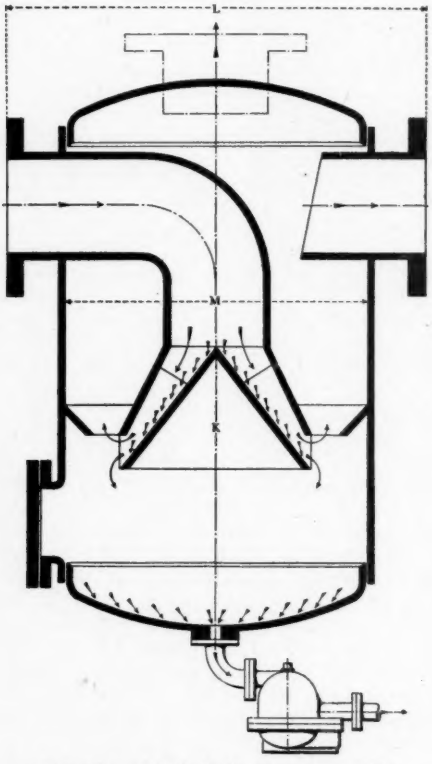


Fig. 2b.—Welded Air Separator with Repulse Cone.

temporary interruption of the power supply. Switch " Y " operates the pilot circuit.

When the starting procedure is carried out the rotary switch will hold in the pilot circuit for 20 seconds, during which normal oil pressure should be established. This should then extinguish the lubricating-oil indicating lamp. All the switches in the protection panel will now be closed and maintaining a circuit to the relays in the indicator unit. All indicating lamps will be extinguished and the switchgear pilot circuit taken through the rotary switch will be held in.

Control over fault conditions is performed as follows :—

Advance warning is given of rising L.P. discharge temperature or rising H.P. discharge temperature. In either event the appropriate warning switch in the protection panel will break the circuit to its associated relay in the indicator unit. This will cause both pairs of relay contacts to close, one to energize the alarm bell and the other to energize the appropriate warning lamp.

The lamp will continue to glow to indicate the cause of warning and the bell will continue to ring until the fault is cleared or the supply to the protection equipment is interrupted. Immediately warning is given steps should be taken to clear the fault before the temperature rises to the shut-down setting. If the fault is cleared within this margin the warning switches and relays will re-set automatically.

To shut down under normal running conditions it is only necessary to turn the rotary switch to the " off " position. This will break the starter hold-in circuit and the compressor will stop.

Air Distribution System

Oil and/or water in a compressed-air system are most unwelcome contents of compressed air at the points of use. The design of reciprocating compressors operating without cylinder lubrication is progressing and several firms produce pistons with carbon rings, etc., requiring no lubrication. The same applies to modern rotating air-compressor types, but for some work very large sizes are required which are not available at the present in the oil-free piston types and there still remains the very great number of lubricated piston-type compressor equipment in operation. Let us assume, however, that by the use of the correct type of lubricating oil and by cutting down cylinder lubrication the oil consumption has been reduced to the safe minimum. There remains still the problem of taking the water out from the compressed-air mains, which condenses out due to the cooling effect after compression.

Condensate in mains should be reduced to a minimum to prevent : (1) Damage to equipment or to tools because of impaired lubrication ; (2) waterhammer, or (3) freezing in tool exhaust retarding production. The quantity of water that will condense out of compressed air depends on the temperature and humidity of the air, on the degree of compression, and on the final temperature at the aftercooler. Theoretically, it is desirable to reduce the temperature of the air leaving the aftercooler to a point where further condensation in the mains is impossible. This is seldom practical due to the initial temperature of the cooling water. Most manufacturers of coolers standardize on a differential of 15° F.

between the inlet cooling water and the cooled air. Some of the water released is in the form of a fine mist and is taken along in the air stream. Unless a separator is used the mist will be carried into the distribution system and will condense to water. To eliminate this accumulation of water automatic drain traps should be used on the intercooler, aftercooler, and separator. Such drain traps release condensate without the waste of air that occurs when manual blow-down valves are used (Fig. 2*b*). The receiver acts as a reservoir and helps to damp out pulsations, but it also may act as a supplementary condenser in which moisture collects. A drain trap is a necessary adjunct as water collected in the receiver will be carried into the distribution mains under heavy load conditions.

Distribution Line Troubles.—The real compressor capacity depends on the operating pressure at the point of usage. A pressure loss of 20 p.s.i. in a 100 p.s.i. air system can reduce the output of tools up to 35%. The primary cause of pressure loss is undersized piping. Other causes are : (1) Too many sharp bends and fittings ; (2) leaks ; (3) insufficient compressor capacity ; (4) insufficient receiver capacity to meet peak demands, or (5) waterlogging of mains.

Large mains increase capital cost but they also provide capacity to meet peak demands,

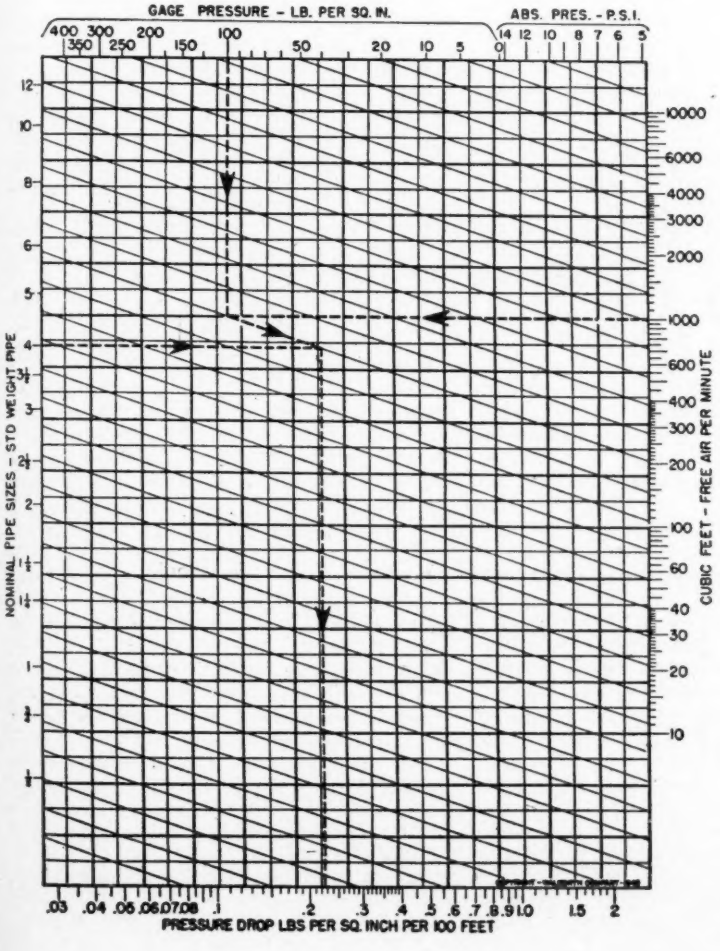


Fig. 3.—Chart for Compressed-Air Flow.

reduce frictional pressure loss, and anticipate possible expansion of air surface.

Checking Leakage Loss.—There is a simple way of making a rough check of leakage loss. First the total volume of the system from the receiver stop valve to the tools including all branches, separators, etc., is estimated. Then with no equipment in use the stop valve closed and with a stop watch the time taken for the pressure in the system to drop 15 p.s.i. noted. The leakage loss per minute is then :—

$$\text{Cu. ft. of free air loss per minute} = \frac{\text{Volume of system (cu. ft.)}}{\text{Time in minutes to drop pressure 15 p.s.i.}}$$

Sizing Distribution Lines.—The correct size of compressed-air distribution lines can be selected by using the chart (Fig. 3), which can be used as shown in an example :—

1,000 cu. ft. of free air per minute are to be transmitted at 100 p.s.i.g. pressure through a 4-in. standard weight pipe. What will be the pressure drop due to friction? The chart is used as follows :—

(1) Enter the chart at the top at the point representing 100 gauge pressure.

(2) Proceed vertically downward to the intersection with the horizontal line representing 1,000 c.f.m.

(3) Next proceed parallel to the diagonal guidelines to the right (or left) to the intersection with a horizontal line representing a 4-in. pipe.

(4) Then proceed vertically downwards to the pressure loss scale at the bottom of the chart. It will be noted that the pressure loss would be 0·225 p.s.i. per 100 ft. of pipe.

Usually the air coming from the compressor plant is not metered and neither is air consumption measured in the lines leading to the various works departments. It is extremely difficult in such instances to say whether a survey and carried-out improvements have produced the desired economy in the use of compressed air, but sometimes compressors maintain the rated pressure during critical peak periods after reconstruction of the plant whereas before the air pressure went down. In certain instances the result of improvements can be ascertained by calculations. The best method, however, is to measure the rate of air flow on important points by means of reliable measuring instruments (Fig. 4). By inserting orifice plates in various points of the pipeline, and by periodically fitting the meter to these orifices, a survey can be based on accurate figures and not on guesswork alone. Portable recording air-flow meters are also available which record the air flow on an instrument chart. For larger air systems, fitting of standard rate-of-flow meters will be a paying proposition because it facilitates the continuous supervision and record charts from meters disclose not only the actual rates of flow at any time but show distinctly irregularities of any kind, thus pointing for investigation of their causes.

Counter Measures.—Once a survey has disclosed the major cause of waste countermeasures are comparatively simple. Too large air outlets on point of use can be eliminated by reducing same. In order to avoid that air valves are left open unnecessarily by the plant operator, some form of alarm signals can sometimes be introduced—for example, based on excessive pressure drop and installation of a pressure gauge with minimum contact.

Air leakage due to defective valves or fittings can be avoided by applying " preventive maintenance " to the whole compressed-air plant. This means that a time schedule is prepared, following which each part of the plant is regularly inspected and tested according to a pre-determined plan. Part of this schedule will be detection of faulty or leaky valves and fittings. Air leakage from pipe joints can easily be detected by applying a soap solution to suspected points. The causes can be manifold—such as, bad packing material, vibration, waterhammer, sagging pipe hangers, or bad roller supports. A survey of leakage of pipework is best made during standstill periods of pneumatic tools served by the air system. The hissing noise of escaping air from leaky points is then a sure guide in addition to the soap bubble method. By fitting a very accurate and responsive pressure indicator to the main header the pressure drop during standstill periods of the plant gives a useful indication about air leakage.

Week-ends and holiday periods are most suitable for chasing leaks in pipework and machinery and for their immediate repair after detection. Insertion of anti-vibration pieces made from seamless metallic flexible bellows tubing often cures development of air leaks and so do adjustable pipe hangers or roller supports which prevent misalignment of the piping system.

Routine Inspection.—To use routine inspection of air connected to an audible alarm compressors are obviously the only means to

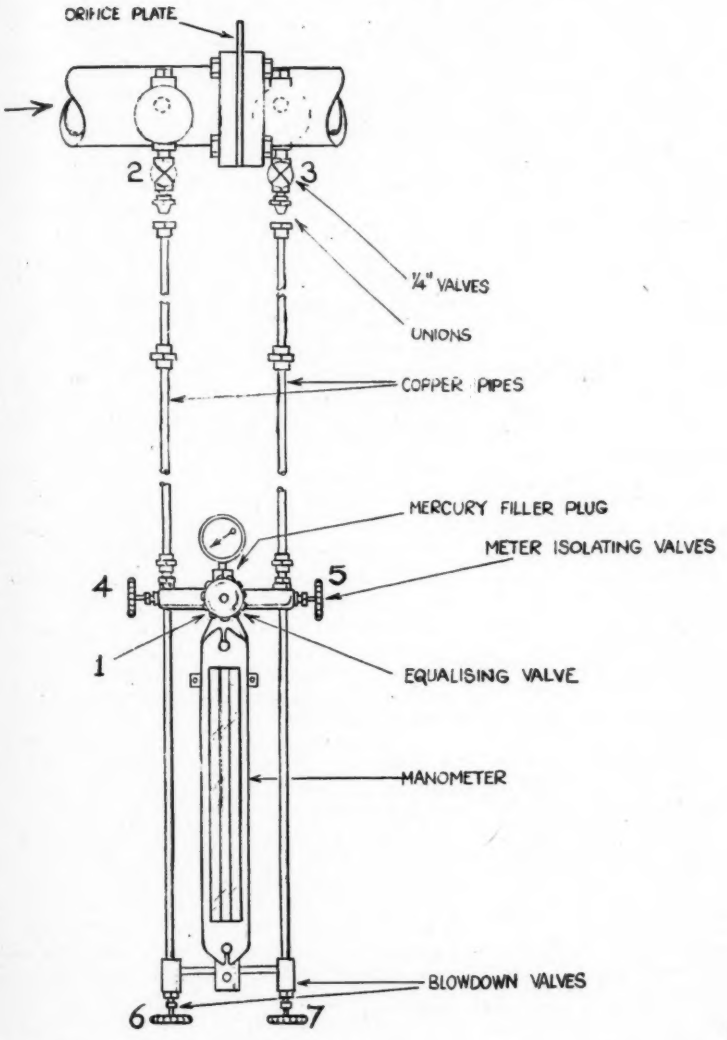


Fig. 4.— Indicating Flowmeter.

(Spirax-Sarco, Ltd.)

ascertain continuous efficient operation. Contrary to an often-heard opinion to leave well alone as long as nothing happens, the writer has found from many years of experience in a consulting capacity that " preventive maintenance " is the only safe method for avoiding breakdowns. The cost of complete shutdowns of a compressor plant in case of failure is always higher than the average cost for periodical inspection and overhaul. Oil starvation of cylinders, worn-out piston rings or liners, bad bearings, damaged oil filters, choked air inlet filters, loose bolts and screws, deposits on cooling water surfaces, or incrustations causing corrosion, jamming of moving parts due to misalignment, and a hundred-and-one causes of trouble can be safely detected in good time if the supervising engineer adopts a plan of regular inspection. In spite of maintenance sudden breakdowns happen, of course, but much less frequently.

For example, if a sudden increase in interstage gauge readings indicates valve trouble it can be assumed that either a broken valve

plate or an obstruction for valve closing (solid particles on valve seat) prevents a valve from closing. If gauge reading at a lower stage occurs a leak past the piston can be suspected. Cracking off of spring ends might finish the lifetime of a valve and cause a breakdown. Generally speaking Continental and American designs with slow speed and long stroke are easier to maintain than the usual British vertical machine with short stroke and high rate of revolution.

(*To be concluded.*)

Ore-Dressing Notes

(5) *Sampling.*

Colorado Uranium Ores

Useful suggestions with regard to practice in uranium-ore sampling are briefly given by G. C. Ritter in *Mining Engineering* for October, 1958. Starting with *minus* $\frac{1}{4}$ in. material cutting is recommended on conventional lines—that is, the whole stream for part of the time. This precludes the use of most stationary types of sampler. The opening between the cutting edges of the traversing device should be at least four times the diameter of the largest particle and the minimum sample size is 100 lb. Where large tonnages are involved a minimum acceptable sample is 2 lb. per ton of ore. This is obtained in three successive cuts of 10%—that is, 10% of the original tonnage and 10% of the product, repeated. Traversing speed must be slow enough to avoid setting up centrifugal force in a rotary sampler—such as, the Vezin, for which 25 r.p.m. is the top safe speed. Particles should not be knocked out of the ore stream by traversing cutters, cross-flight buckets being, therefore, limited to some 18 to 20 cuts per minute. The sample thus cut can be riffled down to 100 lb. and then, after mechanical mixing and drying, it is crushed through 10-mesh and riffled to 10 lb. It is then taken down to *minus* 28 mesh and thoroughly blended before cutting a 2-lb. sample. This in turn is brought to *minus* 120 mesh before rolling and splitting.

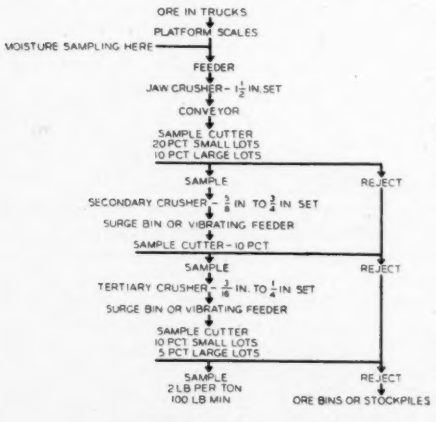


Fig. 1.

Mechanical inaccuracies can arise from poor alignment of the cutting devices, worn cutting edges, excess cutter speeds, poor screening, and contamination or sample loss through bad transport arrangements. A flow-sheet illustrative of good practice (Fig. 1) is given.

(6) *Solvent Extraction.*

Some Resin-in-pulp Problems

In a paper presented at the February, 1958, American Institute meeting Webb, Richards, and Bator describe the R.I.P. process as used by Mines Development, Inc., and discuss some operating difficulties which have been overcome. Excess sulphate was present in the final yellow cake until double precipitation was practised, the ammonium nitrate in the eluant being replaced by sodium nitrate. Loss of the costly resin beads took many months to track down and to correct. These 20-mesh beads are contained in 28-mesh stainless-steel baskets and far too many whole beads were finding their way to the resin traps. Eventually a small basket was made of the same screen material and attached for a cycle to a bank. The resin caught was measured and the basket was then moved to the next bank. This showed where the leakage was worst and inspection disclosed that some screens had failed, split, or been damaged, apparently for the most part either by immoderate flexing or by breaking too many strands during the bolting on of the screens during original installation. Better methods were devised and the trouble ceased. Some trouble has been experienced with leakage of solution; this damages the pH electrodes which meter the acid for the leaching section. The trouble was due to a loosening of the polyethylene gaskets and this is now prevented by frequent use of melted paraffin wax to reinforce the seal. This job takes 2½ hours

and alternatives are under test. This short paper concludes with some operating and cost data, the latter being, per ton : Leaching, $1·60 ; sand washing, $0·22 ; resin-in-pulp, $0·46 ; elution and precipitation, $0·81, a total of $3·09.

(7) *Production.*

Lake Shore

Lake Shore is one of a group of six gold mines in the Kirkland Lake main ore zone. The gold, 20% of which is associated with tellurium, demands fine grinding and part is only accessible to cyanidation after the auriferous pyrite has been floated and roasted. Milling began in 1918 with straight cyanidation and rose from the initial 60 tons daily to a peak of nearly 2,600 tons by 1938. Currently, 1,000 tons is handled. Crushing is followed by fine grinding in cyanide (Fig. 2). The cyanide tail is joined by that from Macassa and Wright-Hargreaves mills and is conditioned for flotation with sulphur-dioxide gas from the multiple-hearth Edwards roaster. After activation with copper sulphate and xanthate the combined pulps are floated. The resulting concentrate is dewatered, given a small addition of sodium chloride, and autogenously roasted. The calcine is agitated in water adjusted for lime and cyanide and given conventional cyanidation before final discard.[1]

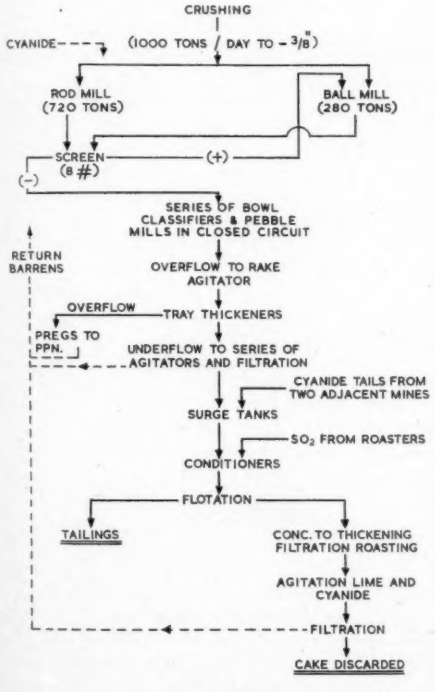


Fig. 2.

(8) *Solvent Extraction.*

Cationic Process for Uranium

A description of the solvent extraction method used at Vitro Uranium Company, Salt Lake City, is given in the American Institute *Transactions* for November, 1958, by W. B. Hall and J. D. Lewis.[2]

Run-of-mine ore is crushed and a 1 lb. per ton sample is taken for control. The ore goes to one of three holding points for blending. Final grinding allows simultaneous processing of two basic types of ore. High-acid consumers can be leached separately. After leaching with sulphuric acid and sodium chlorate the slurry is treated with aqueous sodium sulphide to precipitate molybdenum and copper. Counter-current decantation follows and a clarified liquor is sent to the solvent extraction plant. Here dodecyl phosphoric acid (DDPA) is used as the exchange solvent. This cationic reagent was selected after comparison with anionic exchange solvents and choice was influenced by ease of procurement and good recovery of chemicals for recycling. The solvent is prepared in the plant by reacting stoichiometric quantities of phosphorous pentoxide and alcohol in kerosene at 70° C. The resulting product is hydrolysed with a ½ volume of normal hydrochloric acid at about 80° C. for 40 hours. A final dilution to 3% solution is made with kerosene. This solution is contacted with the uranium mainly in the latter's hexavalent state and transfer time is of the order of 2 minutes. Other ions simultaneously extracted include titanium aluminium, vanadium, and iron—notably, in its ferric state.

Extraction is made in four mixers in series through which organic and aqueous phases travel counter current. Stripping is accomplished by reaction with 10 N hydrochloric acid in a 10 : 1 organic to aqueous ratio. This requires between 20 and 30 minutes and

[1] 6th Commonwealth Congress Volume—" The Milling of Canadian Ores."

[2] See also THE MINING MAGAZINE, Aug., 1958.

is done in five sets of mixer-settlers which make a counter-current flow of loaded organic solvent against the hydrochloric acid liquor. Some of the barren (lean) organic solution is by-passed for further contact with ammonium fluoride in a pH 5 solution. Such metal ions as thorium, aluminium, iron, and titanium are now precipitated as fluorides together with some UF_4. These are filtered off and the fluoride solution is regenerated for further use. The loaded hydrochloric acid is fed to an evaporator to recover most of the acid.

This unique operation recovers over 90% of the available acid at a concentration of 10 N. The unit consists of a two-stage vertical falling-film type evaporator, a dehydrating unit, and a condenser. The pregnant hydrochloric solution carries about 100 grammes per litre of U_3O_8 which is distributed evenly to the top of the evaporating column by a system of weirs. The unit is worked at 215° F. Wet gas passes through a mist separator which entrains solution and adds it to the evaporator bottom discharge. At this point the pregnant solution carries between 300 grammes and 500 grammes per litre of U_3O_8. It now goes to a secondary evaporator unit working at 255° F. and discharging a bottom product carrying from 800 grammes to 1,000 grammes per litre of U_3O_8. Evaporated gas is dried in a tower through which concentrated sulphuric acid flows. It is then condensed to produce 10 N hydrochloric acid.

DDPA has high affinity for ferric iron and extraction would suffer severely if an excess of this was present. Research shows that 1 mole of DDPA extracts 0·5 moles of uranium (hexavalent) and under the same conditions 0·7 moles of ferric iron. This would travel with the uranium to the final product and would, therefore, add to the cost and make a less efficient performance. Similar undesirable effects would follow in the precipitation phase of the work if ferric iron were present. Extraction also requires the ionic form of the uranium to be uranyl for high efficiency. The solvent can extract 0·5 moles or 14 grammes of U_3O_8 per litre of 0·1 N solvent, but if the uranium were in the reduced form (having a valence of $+4$) twice as many theoretical sites would be required for the same loading and saturation of the solvent would be reached at about half this loading.

Letter to the Editor

The Witwatersrand Mineralization

Sir,—If I have disconcerted Dr. Bosazza[1] by my failure (in his eyes !) to practise modern scientific methods, perhaps the fault lies within himself—for the blinkers of placerism have distorted his vision. Let me try to widen his field of view. *First*, he mistakenly assumes that the link-up of the Witwatersrand mineralization to post-Transvaal Bushveld-age granites is based on a single group of age determinations. This correlation, however, has now been demonstrated by no less than four unrelated but convergent lines of geochronological study. *Second*, he equates sedimentary control of the mineralization (a point not in issue at all) with sedimentary origin. A review of the literature on the Michigan coppers can cure this common illusion. *Third*, he sees a sharp cut-off of mineralization at the foot-walls and hanging-walls of the reefs, a cut-off which is non-existent when the values are viewed in the broad light of sedimentary geochemistry instead of the narrow beam of economics. *Fourth*, he is endemically blind to the hydrothermal zoning that can be discerned in the Witwatersrand if one has the eyes to look for it.

I hope I may elaborate these and related topics in a future contribution to THE MINING MAGAZINE. Meanwhile I would add that, notwithstanding Dr. Bosazza's assertion, I have nowhere postulated that the Witwatersrand mineralization took place 1,000 m.y. after the deposition of the bankets. The mineralization is dated at around 1950 ± 150 m.y. and the Witwatersrand sediments are older than this, but younger (probably very much younger) than 2,600 m.y., the date of granitization of the Shamwaian—Bulawayan system. Neither have I proposed movements of fronts from a Bushveld granite for 150, 100, or even 50 miles—and since I have no other reason to doubt Dr. Bosazza's ability to think three-dimensionally, I conclude that such suggestions introduced by him are no more than polemical red herring. So also are his references to feeding channels. Does he really believe that epigenetic additions to the mineralogy of sediments demand the existence of feeding channels? If so, let him ask himself how the magnesium entered the Transvaal dolomites.

[1] V. L. Bosazza, THE MINING MAGAZINE, Jan., 1959, pp. 24–27.

In this Witwatersrand controversy we are being assured on all sides, by Liebenberg, Ramdohr, Nel, Brock, and now Bosazza, that whilst the mineralization bears the stamps of hydrothermal origin, this is but pseudohydrothermalism—it has no connexion with the contemporary granites. Not long ago (*Econ. Geol.*, **53,** 620) I was publicly excluded from Professor Ramdohr's "Greek class" because of my reputedly inadequate knowledge of the language. Apparently the conclusion reached by this class is that the Odyssey was written not by Homer but by some other man of the same name.

C. F. DAVIDSON.

ST. ANDREWS, FIFE.
January 7, 1959.

Book Review

Rock Pressure in Mines. By E. DE ST. Q. ISAACSON. Cloth, octavo, 212 pages, illustrated. Price 45s. London: Mining Publications, Ltd.

In producing what is believed to be the first text book devoted entirely to this important subject, the author has not only drawn on the extensive experience gained as Officer in Charge of the Rockburst Research Unit of the Kolar Gold Fields, but he has also attempted to reconcile some of the conflicting theories on rock pressure which have been put forward by various authorities from time to time. Commencing with the theoretical study of the stresses and strains developed in the course of mining operations and the effect of stresses beyond the elastic limit, consideration is then given to the modifications in stress pattern resulting from various types of non-homogenity in rock such as faults and stratification.

From this the reader is led in logical sequence to the study of pressure control techniques through the correct design and, what is even more important, the layout of the development and stoping operations. Of particular value are the chapters dealing with analyses of the causes of rock failures which have occurred in the author's experience and the actual measurement of underground stresses in which the application of several newly developed techniques are described.

Throughout the book it is gratifying to find evidence that the author has continually kept the practical approach to the subject well to the fore and he rightly stresses the impossibility of generalizing from observations restricted to one particular type of rock when the mode of failure is so dependent on the structure of the rock concerned.

This volume undoubtedly goes a long way towards filling what has previously been an important gap in the average mining engineer's knowledge, a better appreciation of the behaviour of the rock in which his workings lie. Considering the ever increasing depth at which the ore-bodies of the world continue to be exploited, Mr. Isaacson's work will form a valuable addition to the bookshelves, not only of the advanced student, but of all who are in charge of underground operations.

PETER BEST.

☛ Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Engineering Log

Non-sacrificial lead alloy anodes for impressed current cathodization have been approved by Lloyd's for the protection of ship hulls against corrosion, according to an article in the latest issue of *Lead*, the quarterly publication of the Lead Industries Association.[1] The results of actual sea trials on a Royal Canadian Navy destroyer, reported by the Naval Research Establishment, Nova Scotia, are given and show that lead alloy anodes, 98% lead, 2% silver, are superior to graphite, steel, platinum, or magnesium on both economic and technological grounds.

* * *

A new relief valve, designed to allow pressure to be released from a tank in a space vehicle, is equipped with a ball poppet using sapphire. The sapphire is being applied also in hot gas and acid valves. One reason for the choice of the sapphire ball was its polished surface and its capability of standing up to constant hammering against a hard metal seating, according to the manufacturer's report. The hardness of sapphire prevents scratching, erosion, or the likelihood of other damage to the stone, reducing leakage from the valve to a minimum. Its high-temperature strength, chemical inertness, and dimensional

[1] Vol. 22, No. 4, 1958.

accuracy are additional properties of great value. It is in current use for windows and domes of infra-red optical systems, for high-power micro-wave tube windows, and for such uses as spaces and supports in vacuum tubes. Domes and windows can now be obtained to 4½-in. diameter and special configurations of the sapphire are also available from the manufacturer.[1]

* * *

A recent study at the University af Chicago has shown that long-term exposure of mice to minute quantities of nuclear radiation has the effect of speeding up the aging process. The study also indicates that a large single exposure to neutron radiation does less bilogical damage than the same total amount administered in a series of lesser exposures. This finding contradicts the theory that the effects of the amounts are equal. Some 4,500 mice are being used for experiments, which have been under way since 1956. Young mice in the top exposure groups were seen to slow down in growth as a result of radiation. They gained weight at a decreasing rate. At the age of one year all the mice in the top two neutron groups and 20% of those in equivalent gamma groups had severe cataracts, a development usually associated with considerably greater age in mice. This condition was accompanied by a wasting away of the iris of the eye, beginning at the age of 14 months: It is not found in normal mice before the age of 27 months. The brown fur of one in every ten mice exposed to gamma rays turned to spotty grey. All the neutron-exposed mice turned grey. Heavier exposure resulted in an increased lightness ot the colour.[2]

* * *

Oil has now been discovered by the BP Exploration Company 1½ miles east of Gainsborough, in Lincolnshire. A test well drilled by BP struck oil at a depth of some 4,600 ft. and during tests the well has produced at a rate of 15 tons a day. This new find is about 2½ miles west of Corringham, where the company found oil in July, 1958. The company is now preparing to delimit the Corringham field and also the field at Bothamsall, Nottinghamshire, which it discovered earlier last year. Over the past 12 months BP Exploration has continued its search for oil in the United Kingdom, mainly in areas around the existing East Midland oilfields and in Southern England; it has also been searching for natural gas on behalf of the Gas Council. Small accumulations of gas were found in several oil exploration test wells during 1958 and there was further development drilling in the producing oilfields at Plungar and Egmanton. The total production of crude oil in 1958 from the existing BP oilfields in the United Kingdom—Eakring and Egmanton (Notts.), Plungar (Leics.), and Firmby (Lancs.)—was about 80,000 tons.

* * *

Another application of Mylar polyester film promises to result in worthwhile conservation of the talent required for an engineering drawing, as well as an economy of the money invested in its making. Drawings on conventional materials often become yellow, frayed, and worn as a result of handling and from storage and it is frequently necessary for them to be redrawn. New drafting materials are using durable plastic film in place of the traditional paper or coated cloth. The new surfaces are based on Mylar polyester film. They withstand wear and even recurrent abuse and are non-absorbent, reports say, of oil, grease, and water. If these surfaces become soiled they can be cleaned easily without impairing the clarity of the drawing; it is said that because of the superior toughness of the film over conventional materials four times as many erasures may be made. The Mylar based material is being offered by several manufacturers at prices roughly equivalent to the cost of many grades of drawing cloth, and both pencil- and ink-sensitized surfaces are offered.[1]

* * *

A recent Report of Investigations published by the United States Bureau of Mines discusses the "Practical Evaluation of Electrical-Resistivity Surveys as a Guide to Zinc-lead Exploratory Drilling" in Kansas. Such work was successful in locating and defining shallow shale deposits in limestone structures under concealing overburden. Seismic measurements had found and partly defined larger sinks containing slumped shale masses but could not adequately depict the

[1] *Comp. Air Mag.*, Nov., 1958.
[2] *Science Digest*, Aug., 1958.

[1] *Comp. Air Mag.*, Nov., 1958.

configuration of the underlying limestone surface. Shale slumps, it is pointed out, are indicative of structural formations in limestones of the type studied and may represent conditions favourable for lead-zinc deposition.[1]

Skip Winder at Rufford Colliery

The illustrations reproduced here are of a skip winder supplied by Head Wrightson Stockton Forge, Ltd., a subsidiary of Head Wrightson and Co., Ltd., for the Rufford colliery re-organization, which is designed to deal with 520 tons per hour of run of mine coal using mine cars of four tons capacity and bottom discharge skips with a capacity of 12 tons each, together with the Koepe winder towers, shown in the final stages of construction in Fig. 1. The guide tower and air casing are of steel and provided with internal platforms and airlock access doors, fixed spear guides being fitted extending from below the skip discharge point to the top of the guide tower. Hydraulic buffer cylinders with 9-in. bore and arranged two for each skip are incorporated at the top of the tower to arrest the rising skip in the case of an overwind and, as an additional safety measure, a Bennett safety catch gear is provided in the top section of the tower to hold the skip should rope breaking occur during an overwind. The catches are designed for a static

[1] BRICHTON, L. C., and RYAN, J. P. *Rep. Inv. U.S. Bur. Min.*, 5426.

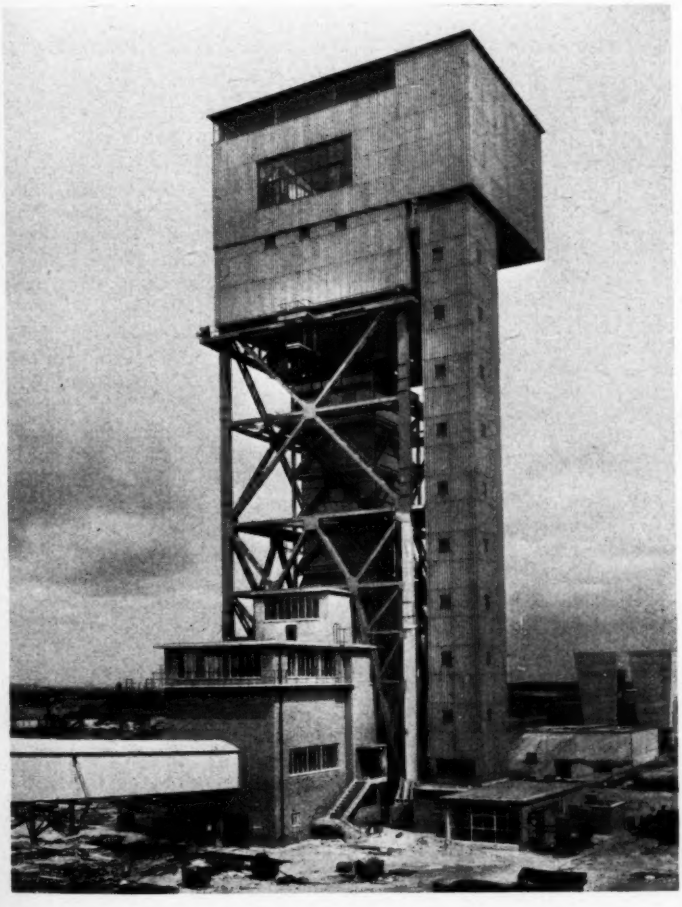


Fig. 1.—Winder Tower Under Construction.

Fig. 2.—Control Desk.

load of 37 tons, falling 10 in. on to four catches.

The bottom-discharge skips incorporate an anti-breakage device fitted with a guillotine-type bottom-discharge door, which is pneumatically operated when the skip reaches the discharge position. Men and material can be carried by the skips, each of which is approximately 4 ft. 4 in. wide by 13 ft. by 32 ft. long. The receiving hopper has a capacity of approximately 36 tons and it is totally enclosed and provided with pneumatically-operated doors at the top and bottom, interlocked to form an airlock for the passage of coal from the upcast shaft to atmosphere. As the skip arrives in the discharge position it contacts an in-line gear and valve which operates the pneumatic cylinders opening the discharge door on the skip and the top door on the receiving hopper, provided the bottom guillotine door on hopper is closed. When the skip leaves the discharge position the action is reversed so that the coal can pass on to an apron feeder. This is 54 in. wide and has an articulated steel apron carried on 6-in. pitch roller chains operating on driving and trailing sprockets. It has apron chains carried on the top by steel channel tracks and on the underside by cast-iron rollers spaced at intervals. The material is retained on the apron by steel skirts and the drive is from a 10-h.p. 720-r.p.m. electric motor through a reduction gearbox and a chain drive to the headshaft. The speed of the apron plate is approximately 50 ft. per minute.

Men and materials winding is carried out from the shaft collar level and hand-operated hinged platforms and sliding gates are provided. Skip changing is also done from this level and to facilitate these operations a crawl beam and special skip bogie are provided.

The multi-rope suspension gears are of the four-strand type and each strand has a minimum factor of safety of 10 in relation to the maximum static load of 12·5 tons per rope end—50 tons per four ropes. Each strand incorporates a load capsule and gauge so that loads on each rope can be checked. Individual components have been proof-tested to not less than 2·5 times their proportion of static load. The balance rope suspension gear is of the swivel type and there are two ropes attached to the underside of each skip.

The compressed air for the whole of the skip surface pneumatic equipment is obtained from two twin-cylinder, two-stage, self-contained water-cooled compressors.

All controls for the surface equipment are grouped on one panel situated in the control house (Fig. 2) at skip-discharge level and while the plant is arranged for automatic winding an overriding control is incorporated in the system to allow manual operation if and when required.

News Letters

VANCOUVER

January 5.

Mineral Production.—The value of mineral production in British Columbia for 1958 has been forecast at $149,000,000 in a preliminary estimate by the Hon. W. K. Kiernan, Minister of Mines. The figure compares with the actual value of $172,264,617 in 1957. The values of the various metals, minerals, and fuels have been estimated as follows (figures in brackets are for the year 1957) :—

Gold, lode and placer, $6,575,000 ($7,546,066) ; silver, $7,350,000 ($7,077,708) ; copper, $3,350,000 ($7,631,897) ; lead, $32,675,000 ($39,568,086) ; zinc, $43,550,000 ($50,225,881) ; iron, tungsten, and nickel, $6,475,000 (iron and tungsten, $7,441,116) ; by-product metals (includes antimony, bismuth, cadmium, indium, and tin), $3,525,246 ($5,314,246) ; industrial minerals (includes asbestos, gypsum, sulphur, and others), $12,560,000 ($13,361,751) ; structural materials (includes clay products, lime, limestone and cement, rock and building stone, sand and gravel), $23,100,000 ($25,626,939) ; coal, $5,575,000 ($7,340,339) ; petroleum and natural gas, $4,200,000 ($1,130,588).

Quantity decreases were recorded for copper, coal, tungsten concentrates, gold, and for some other products ; increases were recorded for natural gas, petroleum, and iron ore. Nickel is essentially a new item, but production was suspended before the end of the summer of 1958. The reduced value of metals stems mainly from reduced output of copper and tungsten and reduced prices for copper, lead, and zinc. The prices of those metals for November averaged considerably higher than for the preceding ten months. The large increase for natural gas reflects the first full year of operation of the transmission lines bringing gas from north-eastern British Columbia to the southern part of the province for export.

Mr. Kiernan states :

"A great deal of exploratory work was accomplished particularly in the Highland Valley-Merritt area, where copper properties were explored with encouraging results ; and in north-eastern British Columbia where to the end of November 13 oil wells and 19 gas wells were added to the list of commercial wells."

Granby Consolidated.—The Granby Consolidated Mining, Smelting, and Power Co., Ltd., has petitioned the Provincial Government seeking wide powers to engage in all phases of the mining and petroleum industries or any other industry. It is proposed to change the title of the company to " The Granby Mining Co., Ltd.," and to increase the authorized capital to 2,000,000 shares from the present limit of 600,000 shares, of which only 450,000 shares have been issued. The original company was incorporated in 1901. A meeting of shareholders is to be called in February and it is anticipated the Legislature will consider a private bill to authorize the changes and powers sought during the forthcoming spring session. It is understood that control of the company has in recent months shifted from New York to Vancouver.

The Granby company seeks to " acquire, own, lease, prospect for, open, explore, survey, develop, work, improve, maintain, and manage either for its own account or for others, petroleum and natural gas wells, permits, concessions, reservations, and lands believed to contain or to be capable of containing and producing petroleum and natural gas, and, either for its own account or others, to drill for, search for, win, get, pump, refine, distill, analyse, manufacture, treat and prepare for market, store, transport, pipe, sell, buy, exchange, and otherwise deal in petroleum and natural gas and the components and by-products thereof."

The company is further seeking powers " to acquire and develop any other natural resources, whether alone or in conjunction with others ; to engage in transportation including the business of common carriers and to carry on, whether alone or in conjunction with others, any business or businesses which can conveniently be carried on in connection with the company's business or which may be deemed to be directly or indirectly for the development of the company." Granby also asks for authority to invest or take part in the management, supervision, and control of the business or operations of any undertaking shares or securities of which are held by the company or in which it is otherwise interested. Authority is also sought to carry on any of the company's operations without restriction as to amount in any province of Canada or in any foreign country.

Bedwell River Gold Mines, Ltd.—A recently-incorporated British Columbia company, Bedwell River Gold Mines, has acquired the mineral claims formerly held by Musketeer Mines, Ltd., and Buccaneer Mines, Ltd., 27 miles north of Tofino on Vancouver Island.

The company has purchased and refurbished the Musketeer 50-ton flotation mill, rehabitated the underground workings of both mines, and now with a crew of 15 men is mining and milling 30 tons of ore daily. Concentrate is at present being stockpiled but is to be shipped directly to the Tacoma smelter by truck as soon as a short distance of road is constructed to provide connexion with main Island highways. The company is headed by Mr. Sam Craig, the prospector who first staked the Buccaneer claims. He states 12,000 tons of ore have been blocked out in the Musketeer and 8,000 tons in the Buccaneer. Withdrawals are at present being made from three stopes on three different levels of the Musketeer. After sorting one-third of the material taken in the 2-ft.-wide stopes, millheads of approximately 1 oz. of gold to the ton are being obtained. As compared to the shrinkage stoping methods now employed at the Musketeer the Buccaneer is being prepared for cut-and-fill mining methods which are expected to produce a cleaner ore and permit an improvement in mill heads.

There are 13 known veins on the combined holdings, the principal of which are the " Trail " and " Main " veins in the Musketeer and the " Buccaneer " in the Buccaneer. The ore has been found to maintain width and grade without diminution in the present bottom horizon 300 ft. below surface and chances are considered excellent for adding materially to reserves at depth. Owing to the efficiency and low cost of the operation Mr. Craig anticipates a clear profit of $5,000 monthly.

Bedwell River Gold Mines, Ltd., has an authorized capital of 200,000 shares of a par value of $1 each. These include 50,000 preferred, cumulative, convertible, 5% shares and 150,000 common shares, of which 50,000 shares have been issued for properties and the remaining 100,000 shares have been issued to pay off all pre-production expense. The preferred shares will be sold as required to pay current accounts and to provide working capital.

Vancouver.—The Howe Sound Company has commenced hiring an operating crew for the re-opening of the Britannia copper-zinc mine, 30 miles north of Vancouver. At present 30 men are employed and it is proposed to build up the personnel to 350 with a view to utilizing 1,200 tons of the 7,500-ton daily capacity of the concentrator. A new operating company is to be incorporated, owing to the liquidation last year of Britannia Mining and Smelting Co., Ltd.

New Westminster.—Pacific Nickel Mines, Ltd., has been advised by Western Nickel, Ltd., of the basis of settlement resulting from lengthy negotiations with European purchasers who were unable to fulfil their contract to accept delivery of further nickel from the operation at Choate. These terms include substantial cash payments and further monthly receipts from October, 1958, to December, 1959. Shareholders of Pacific Nickel have been advised by Col. Victor Spencer, president : " It would appear that the present arrangements will be carried out, in which event your company will before the end of 1959 be again in possession of its investment portfolio and, it is hoped, will also have been paid the $242,600 cash advance to Western Nickel, Ltd. At this date (December 15, 1958) the value of Pacific Nickel's investments represent approximately 50 cents per share, not including the $242,600 mentioned."

Alberni.—Shareholders of Privateer Mine, Ltd., have approved the re-organization of the company on the basis of surrender of five shares of Privateer to receive one share in a new company to be known as New Privateer Mine, Ltd.

Highland Valley.—Torwest Resources, Ltd., has received a progress report from Geophysical Explorations, Ltd., covering the spontaneous-polarization survey to date on the huge Swakum Mountain holdings of the Torwest company. Mr. Sherwin F. Kelly, the president of the geophysical company, who has taken active charge of the work, describes the reactions as being unusually impressive in indicating " very advantageous targets for investigation by diamond drilling." Two diamond drills are currently at work on the property. Mr. James S. Scott, until recently manager of Kennecott Copper Corporation's Canadian exploration, has been engaged as consulting geologist and is now at Swakum Mountain. The company has made some important changes in its board of directors and expects to announce an important underwriting early in the new year.

Slocan.—Guichon Mine, Ltd., regained possession of its various mining properties after completing all legal requirements on October 23, 1958. The properties had been assigned in 1956 to Western Copperada Mining Corporation, of Montreal, which company undertook to carry on the development programme. A serious effort was made and Western

Copperada is reported to have expended $196,650 in pursuit of its purpose. Unfortunately the company became over-extended in its involvements with additional properties and was forced into bankruptcy. Upon gaining repossession, Guichon immediately resumed exploration on its own part and staked eight more claims north-east of the original holdings of the Copperada property near Nicola. On the Copperada holdings an electromagnetic survey conducted at a cost of $30,046 had indicated 31 anomalies. Other Guichon holdings include the two Crown-granted claims constituting the Buckeye lead-zinc property at Ainsworth; the Quilchena gold prospect of seven Crown-granted claims, north-east of the Copperada property and also in the Nicola mining division, and a lease covering natural gas and oil rights on 48,000 acres of land in the name of Guichon Cattle Co., Ltd.

TORONTO

January 27.

Gold Production.—The output of the Gold Mines of Ontario for November last included 219,351 oz. of gold and 30,989 oz. of silver, valued at $7,490,094, from 783,065 tons of ore milled.

Sudbury.—Following the settlement of the strike at the International Nickel Co. of Canada last month operations were resumed on December 26 and it is hoped production will soon be proceeding at a higher rate than that obtaining before the stoppage. The labour force is reported growing and it is announced that the Murray Mine closed in July last is being re-opened for production.

Manitouwadge.—Geco Mines reports a profit of $2,010,300 for the three months to September 30 last, a figure it is expected will be increased for the final quarter of the year. In the September period the mill was treating 3,532 tons of ore daily.

Alberta.—Rix-Athabasca Uranium Mines reports a profit of $171,800 for the three months ended September 30 last. For the first nine months of 1958 the net profit was $382,000 as compared with a loss of $146,000 for the same period of 1957. The customs mills treated 54,075 tons grading $24·72 for a gross revenue of $1,437,000 during the first nine months, as compared with $904,000 from shipment of 33,120 tons with a recoverable value of $26·96 for the first nine months of 1957.

Manitoba.—Production by Sherritt Gordon Mines from Lynn Lake is now proceeding normally, it is stated, and lateral development is now under way on the 2,000-ft. level from the Farley shaft. The downward extension of B ore-body has been picked up some 450 ft. below the lowest level previously included in the ore reserve and it is anticipated that a substantial tonnage of ore will be developed in this lower part of this ore-body. Good progress has also been made with construction of the permanent plant of the Farley shaft during the quarter. The hoist house has been erected and the new hoists are being installed. The permanent head-frame is being erected while the sinking head-frame is still in operation. Excavation for the mill extension has been completed and foundations have been partly completed.

The Hudson Bay Mining and Smelting Company reports a profit of $2,248,899 for the third quarter of 1958, sales for the period totalling $13,597,634.

Quebec.—The gold output from Quebec mines for September last has been given as 91,074 oz., bringing production for the first nine months of 1958 to 771,997 oz. The September silver production was 343,692 oz. and the nine-month total for that metal 2,946,292 oz. Comparable asbestos figures are 84,931 tons and 618,811 tons.

It is reported that a company called Wiltsey-Coghlan Mines, Ltd., is carrying out a diamond-drilling programme on their property adjoining Noranda ground on the east. The drilling is being concentrated on a copper sulphide zone extending across the property for upwards of 2,000 ft. During the past 15 months about 40,000 ft. of drilling has been done and this has indicated numerous favourable structures.

In the first nine months of 1957 Noranda Mines, Ltd., production totalled $22,168,000, costs being given as $11,631,000. In the September quarter the net income was $2,040,000.

The improved outlook for base metals, particularly copper, has encouraged the Bateman Bay Mining Company to complete unwatering of the shaft at its copper-gold property in the Chibougamase area and driving at the 250-ft. level is said to be under way. It is intended, it is stated, to deepen the shaft in order that deeper levels can be opened.

At Nolartic Mines the 540-ft. shaft is to be deepened so that four new levels can be opened, drilling below the 500-ft.

level having proved encouraging. Ore reserves at this property are estimated at about 1,000,000 tons and it is hoped to be shipping 1,000 tons daily in the coming summer to the mill at Malartic Gold Fields.

MELBOURNE

January 20.

Great Boulder Gold Mines.—This Western Australian gold-mining company has reported that for the 12 weeks ended November 25, 1958, total development amounted to 3,381 ft., of which 1,348 ft., or 39·9%, was in ore of a grade of 4·0 dwt. or over. Considerable development is being done at shallow levels with good results. At Doolette shaft, on the 200-ft. level, 97 ft. sunk in the Golden Sellar winze averaged 10·7 dwt. over 5 ft. and Robs Caunter winze at the same level averaged 4·9 dwt. over 5 ft. for 16 ft. of sinking. At the 400-ft. level the north-west spur Robs X lode was worth 7·8 dwt. over 7 ft. for 47 ft. and the west cross-cut Section 45C intersected 6 ft. of ore worth 5·7 dwt. At the 1,400-ft. level of the Main shaft the South drive Fault " A " averaged 5·6 dwt. over 6 ft. for 371 ft. At the 1,750-ft. level the East Branch Ivanhoe East winze was sunk 23 ft. in 10·6-dwt. ore over 5 ft. Driving at the 2,800-ft. level on the Main lode west branch, averaged 7·2 dwt. over 5 ft. for 57 ft. At Edwards shaft 400-ft. level a north drive was in ore assaying 6·6 dwt. over 7½ ft. for 66 ft. At the 1,750-ft. level the south drive Fault " A " was worth 4·1 dwt. over 6 ft. for 92 ft. The north drive on " 29 " lode at the 2,950-ft. level assayed 6·4 dwt. over 5½ ft. for 90 ft. and rising on No. 61 Cross lode at the 3,100-ft. level for 54 ft. was on ore worth 5·2 dwt. over 5 ft. At Hamilton shaft the north drive on Eighteen lode at the 2,500-ft. level gave 47 ft. worth 5·7 dwt. over 5 ft. and 32 ft. worth 6·1 dwt. over a similar width. At the 3,100-ft. level the north drive on No. 2 West lode assayed 4·1 dwt. over 5½ ft. for 54 ft. and driving north on No. 3 West lode, at the same level 16 ft. assayed 11·3 dwt. over 5½ ft.

In the Western Leases driving is being done from the Lake View and Star workings at the 2,800-ft. level where the north drive on the New lode averaged 7·7 dwt. over 5½ ft. for a distance of 155 ft.

These results are comparable with those reported for the major part of the year and are a very satisfactory indication for the future of the mine, not only at the shallow and intermediate depths but particularly at the deep levels.

Emperor Gold Mines.—Emperor Gold Mines, Fiji, is developing well and prospects for the future of the mine appear good. In the year ended June 30, 1958, a record gold production was achieved and mine development was increased to 20,161 ft.; reserves of measured ore were increased to 800,000 tons with an average grade of 8·1 dwt. and indicated ore increased to 279,000 tons, with an assay value of 8·2 dwt. The mill treated 180,888 tons of ore for the recovery of 74,930 oz. of gold, a recovery grade of 8·5 dwt., as compared with 7·9 dwt. per ton in the previous year. Mine operating costs were reduced from 94s. per ton to 90s. per ton due to the larger tonnage of ore treated, development costs being excluded from the figures.

Proposed alterations in the mill are expected to increase capacity to the limit of the ore supplies available from the mine and development results are reported as very satisfactory, with good future possibilities in the eastern ore-bodies. The Crown lode, particularly, shows good results and considerable lengths of ore are reported at Nos. 10, 11, and 12 levels. At No. 11 level driving has opened up a continuous length of ore assaying ½ oz. gold over a width of 48 in. The exposed length of lode on the Prince lode at No. 10 level is stated as 2,400 ft. and a further length of 500 ft. is expected. At No. 11 level this lode for a length of 250 ft. has a value of 9·5 dwt. over a width of 60 in. At No. 12 level the lode has been opened up for a similar length in ore of the same grade and width and is expected to give a length comparable to that disclosed on No. 10 level.

The Fijian Government has given a subsidy of £2 per oz. of gold to operate from June 19 last for a period of three years, payments not to exceed £150,000 in any one year. This will be valuable in financing future heavy expenditure on development and plant and should obviate any call on shareholders. The future for Fijian gold mining is considered to be very favourable.

Bauxite.—Development of the Weipa bauxite deposit on Cape York Peninsula by Commonwealth Aluminium Corporation is attracting much overseas interest. Canadian, United States, and Japanese concerns are examining and prospecting in the far north of

Queensland and in the Northern Territory. Expenditure by Commonwealth Aluminium Corporation at Weipa is said to exceed £A1,000,000. In the Northern Territory the Commonwealth Aluminium Corporation has been granted a Special Mineral Lease of 22 sq. miles on the Gove Peninsula, which is known to contain important bodies of bauxite, but more test work is necessary before the commercial importance of the area can be assessed.

Assistance to Mining.—Some time ago the Victorian Government made monies available for the search for base metals in the rugged north-east of the State. Later it was pointed out that Victoria's prospects as a base-metal region were negligible but the State had always been a gold province of great importance. The Government has since decided to make the grant available for the search for gold by way of subsidy to assist diamond drilling on approved projects on a pound for pound basis. It is noteworthy that the gold mineralization is largely concentrated in an area of 5,000 sq. miles and that in the past this area has been amongst the richest areas in the world. There is strong probability that concealed ore-bodies exist and their discovery calls for an active policy of geological survey followed by diamond drilling.

Gold Mines of Australia has been drilling at the Stawell goldfield for some time and the work done is advancing toward the proving of a new auriferous area that could be of considerable commercial importance under existing conditions but would be of greatly enhanced value if the world price for gold were raised. Other localities in the State offer attractive prospects in exploration, but, with the exception of large organizations, the general public is hesitant to face the risks involved when the existing market price for gold is inadequate. Government assistance in preliminary geological, geophysical, and diamond-drilling work would give valuable incentive to the search.

Gold Production.—The Commonwealth Statistician has reported that the Australian gold production during October, 1958, was 93,409 fine oz., which was a decrease of 5,129 oz. on that in September. Of the total, Western Australia produced 78·3%, the Northern Territory 7·6%, and the balance of 8·1% was raised by the remaining States. The present producing mines in Western Australia promise substantial life, providing operating conditions do not deteriorate much from the present level. There is increased activity by prospectors in the State and the State Government is giving useful technical and mechanical assistance, while important financial aid is made available in approved cases. The Commonwealth Government's subsidy has been, and is, an important factor in maintaining the industry.

The importance of the Northern Territory as a gold producer, now second on the list, depends upon the Tennant Creek field which has peculiar geological features, the big problem being that of recurrence of auriferous shoots at depth. Substantial Government expenditure on exploring the relationship of auriferous occurrences with the haematite anomalies might add substantially to the productivity of the field. In this regard the exploratory work being done by Peko Mines on that company's Orlando lease opens up interesting possibilities in the way of establishing the existence of a gold zone at greater depth than that which has been exploited so far.

Uranium in Victoria.—Showings of uranium in Victoria have been very indifferent and some interest was caused by the discovery of radioactive material in a granite quarry in the Lake Boga district, in the north-west of the State. Examination by the Department of Mines does not indicate that the discovery is important, the uranium mineral being located on cleavage and fracture planes in the granite. It seems, so far, that uranium occurrence in the Commonwealth is located in the far north and the centre and invariably in the arid regions. Occurrence of uranium mineral is widespread, but the commercial deposits and those with pretensions to commercial grade have all been located in the centre and north.

Lead and Zinc Prices.—The only producers of refined lead and zinc in Australia are Broken Hill Associated Smelters, Ltd., at Port Pirie, South Australia, and the Electrolytic Zinc Co. of Australasia, Ltd., at Risdon, Tasmania. It is reported that these companies have raised the domestic selling price to a fixed figure of £A100 per ton for each metal. At the end of 1958 the price for local sales was £85 12s. 6d. for lead and £93 12s. 6d. for zinc. The increase in price will benefit the Broken Hill mining companies and the West Coast, Tasmania, mines of the Electrolytic Zinc Co., returns to which will be appreciably higher. Mount Isa Mines and other producers who do not have their products refined in Australia will not benefit.

Australian lead production is 192,000 tons per year and local consumption of metallic lead approximates 40,000 tons. The Commonwealth production of zinc is 110,000 tons and local sales account for 80,000 tons of metal.

Coal-Mining Industry.—The reorganization of the black coal-mining industry in New South Wales is having the inevitable result of closing down unprofitable collieries and dismissal of employees. Efficiency is reaching a high level and mechanization has been highly developed. As a result production per man shift has been increased substantially and the price of coal has fallen to a level at which it is competitive with alternative fuels and the long-defunct export trade is being re-established and is now about 1,000,000 tons of coal per year. Ground lost to oil and Victoria brown coal is serious and cannot be regained, a loss occasioned by long periods of organized industrial unrest on the coalfields. With realization of the ultimate result of this policy and increasing industrial peace over very recent years the economic position has been greatly improved.

Old tactics persist, however, the latest closure being Cessnock No. 1 colliery, one of the largest on the Cessnock field. The company is unable to market coal at the cost of production although the mine is mechanized and it is stated that this position is due largely to strikes during the past half-year when 22½ days were lost through this cause, involving loss of 11,000 tons of coal in local sales and 10,000 tons in exports. There are substantial reserves in the mine, markets are available, and the coal is high grade. Dismissals on this and neighbouring mines now approximate 900 men, part of whom can be absorbed elsewhere.

With greater efficiency in the industry output of black coal has reached record figures and the output is being utilized and will continue to meet increasing local and export demand. Eastern Asia is coming into the field for coal from Australia and New Zealand and the demand from this quarter is expected to continue. In Australia there is steadily increasing demand for coking coal for the expanding steel industry and for steam coal for thermal power stations planned, or in course of construction. Apart from the long-standing loss of export trade the New South Wales industry has been heavily hit by the loss of the Victorian gas-coal trade, for gas is now being manufactured from brown coal on the Morwell field and is piped to Melbourne. The growing use of diesels in New South Wales and Victoria has heavily cut the demand for locomotive coal. In the industrial field coal is making progress, due to washing and grading, the former practice resulting from the increasing ash content following the development of mechanized mining.

Nickel.—Search for nickel in Australia has been unsuccessful so far. The International Nickel Co. of Canada, which has prospected a large area on the border of South Australia and Western Australia over a period of two years, is moving its headquarters from the field to Adelaide and abandoning the small township established in the area. South Western Mining, Ltd., which holds areas in north-western South Australia, has had its leases extended for a further period of three years. It is stated that prospecting work will be continued during 1959 in country where a large occurrence of low-grade material is considered to exist.

Oil Search.—Interest in possibilities for oil in Australia is increasing. A recent development is the acquisition by Santiago Petroleum Corporation of a 75% interest in a petroleum concession of 3,200,000 acres in Queensland, and an application for an interest covering 22,400,000 acres. The locality of interest is 700 miles west of Brisbane. The survey of the Great Barrier Reef, between Maryboroung and Thursday Island, by the Commonwealth Government's Bureau of Mineral Resources, has been resumed using a specially equipped launch.

Following the finding of oil at Puri, in Papua, Australasian Petroleum Co. is applying for new areas in Papua, covering 8,950 sq. miles.

In Western Australia two new wells have been commenced by West Australian Petroleum Pty., Ltd., about 100 miles inland from Broome and work is being pushed on despite the abnormal wet season.

FEDERATION OF MALAYA

January 10.

Prospecting.—Sir Douglas Waring, who represents the mining interests, said in the Federation of Malaya Legislative Council that the Government's job was to liberalize the prospecting policy, which would enable private enterprise to comb the land for tin and other mineral deposits. In the process of planning the nation's development care must be taken so that the cart was not placed

before the horse, he said, during a debate on the Ministry of Natural Resources budget. It was not possible to plan without first ascertaining what was underneath the surface of the ground and it was useless to allocate land for agricultural or other purposes only to find that the land had sizeable deposits of minerals. Sir Douglas said that mining interests were not slow in going about their prospecting. Once they received prospecting licences from the Government they would go right ahead. He agreed with a suggestion that land in Malay reserves should be prospected. Villagers could be resettled while their land was being mined. They could be given shares in the mine and after the land had been worked out they could return to the area to restart their homes.

The Sultan of Perak said in the State Council that it was the Government's hope, with the easing of the emergency situation (the war against the Communist terrorists in the jungle), to remove restrictions which had hindered tin prospecting in certain areas. Consideration, he said, was also being given to extending mining to outlying areas. The effects of tin restriction had been felt not only in mining circles but by allied businesses and industries as well, due to the predominant position tin mining occupied in the economy of the State. He said that at the end of September last year there were 22 dredges, 207 gravel pumps, and 13 miscellaneous mines operating in Perak, where prior to the introduction of tin restriction there were 43 dredges, 392 gravel pumps, and 10 other mines in operation.

Unless the Government opened up new land many Chinese-owned mines would have to be closed down, Mr. Cheong Kai Swee (representing Chinese mining) warned the Perak State Council, in the Federation of Malaya. After the war, he said, mining operations in Perak had been mainly confined to land which had been earmarked since the pre-war period. The present tin restriction was only a temporary measure, he said, but taking a long-term view the millions of dollars needed to develop a young and independent Malaya could best be obtained by utilizing to advantage the country's resources in tin-bearing land.

Steel.—Malaya could develop its own steel industry, said Mr. S. K. Jagatheesan, managing partner of the Malaya Mining Company, it is reported from Ipoh, when he was discussing the future of the iron-ore industry. Japan's refusal to buy more than 1,600,000 tons of Malayan iron ore a year was due to a recent agreement Japan had signed with India, he said. Japan had contracted to double purchases from India to 3,000,000 tons for a 20-year period. This was in addition to the 1,500,000 tons Japan would continue to buy from Goa. The remainder of Japan's needs of 8,500,000 tons of iron ore would be met by South America, the Philippines, and Hong Kong.

Malaya had only one overseas market for iron ore—Japan—but Malaya could develop a steel industry and for this purpose could import high-grade coal from India.

Negotiations have been going on concerning the right to prospect for iron ore on the estates of United Patani (Malaya) Rubber Estates in Kedah, Malaya. Mr. H. D. Husband, the United Patani chairman, had visited the estates, accompanied by a mining consultant, to investigate the position, following an approach by a syndicate seeking the right to prospect for iron ore on the estates. Mr. Husband said investigations disclosed that there were large deposits of iron ore on the estates, but the quality of samples was poor. Nevertheless, the syndicate continued to show interest and broad heads of agreement were negotiated with it, subject to a formal contract to be entered into later.

Steel for Malaya.—India will export commercial steel of all kinds to Malaya in 1961 when her three big steel plants begin production, according to Mr. K. Chowdhary, a member of the Indian Export Promotion Advisory Council, who spoke on this subject when visiting Singapore.

Cement.—The manufacture of cement in Sarawak, Borneo, as a long-term project is being explored, it is reported from Kuching. Geological work has revealed large reserves of suitable materials.

Tin Export.—The Federation of Malaya Government has announced that the country's permitted exports of tin metal in the fifth control period, from January 1 to March 31, would be 7,500 tons. This is in accordance with the decision of the International Tin Council that permissible exports by the six countries in the agreement would remain unchanged at 20,000 tons for the three-month period.

Ceylon Ilmenite.—An ilmenite project of the Ceylon Government due to go into operation in February, 1959, has a production estimate of 60,000 tons annually. A Japanese expert is in charge of the project.

JOHANNESBURG

January 24.

Transvaal.—Winkelhaak Mines, now officially in gold production, reported ore reserves at December 31, 1958, of 1,200,000 tons averaging 5·7 dwt. over 58 in. By the same date 32,485 ft. of Kimberley Reef had been sampled, with 21,108 ft. payable, averaging 6·5 dwt. over 58 in. Drilling results in and close to the lease area indicate a grade range of 4·8 dwt. to 5·7 dwt. over 58 in. The ore reserve width if maintained suggests a high-tonnage mine calling for a high milling rate.

While the footage is admittedly very limited, 450 ft. first sampled values from the deeper section of Hartebeestfontein in the final 1958 quarter were disappointing—163 in.–dwt. against 442 in.–dwt. in the shallow upcast section, where operations previously were concentrated. Sampled values over the four quarters backwards from December, 1958, averaged 425, 460, 415, and 388 in.–dwt., the respective yields being 11, 10·933, 10·966, and 10·966 dwt. a ton against the ore reserve grade of 9·73 dwt. over 39·4 in. last June, as compared with the average borehole grade range of 5 dwt. to 9 dwt. approximately over the same width. The gold plant which treated an average of 87,000 tons a month in the final 1958 quarter is being expanded.

Orange Free State.—The two haulages from the Virginia mine into the lease area of Merriespruit have been advanced sufficiently far to permit development towards the Basal Reef horizon in the near future and sampling results over a limited footage are expected to be included in the quarterly report for the period ending March 31, 1959. From one of the two haulages 22 boreholes have intersected the Basal Reef, 14 disclosing payable values averaging 375 in.–dwt. and 19 in.–lb. of U_3O_8 over a channel width of 44 in. Boreholes drilled from surface indicated an average grade range for the lease area of 220 in.–dwt. to 340 in.–dwt., with payability of 55% to 65%.

Further marked progress has been recorded by Free State Geduld in advancing operations towards the two Geduld bore-holes on the southern boundary. In addition to the heading which was driven to a point on the boundary between the two bore-holes four other twin-headings are now approaching the zone. While numerous dykes have been encountered the zone penetrated has been relatively free from major faulting. The reef horizon in the Geduld No. 1 bore-hole is at a shallower depth than the levels presently being advanced southwards and is a faulted zone characterized apparently also by numerous dykes and water-bearing fissures. With tonnage the main consideration up to the present, the mine has concentrated on providing this and avoiding the spectacular which would have yielded little of priority mining importance. However, the position now reached in this extreme southern section will permit of development laterally towards the No. 1 bore-hole this year. Workings in the area of No. 2 shaft, which serves the southern zone, are confined to levels above 53 level, immediately above which a concrete plug was installed to seal off an inrush of water in 1953. Since then the water table and inflow and pressure have fallen markedly and this more favourable position has facilitated the start of operations to reclaim the shaft below the plug. In the No. 1 shaft to the west of No. 2 most of the recent development on reef has been advanced in the lower-grade zone north-east of the No. 1, while south of it nearly all the development in what is a relatively heavily faulted zone has been off-reef.

Free State Saaiplaas Gold Mining has completed sinking its No.1 Shaft to its final depth of 5,835 ft., while No. 2 Shaft, sunk to 6,266 ft. by the end of December, has still to be sunk a few hundred feet. Work preparatory to the erection of the reduction plant is now in progress. No reef development has yet been accomplished.

St. Helena Gold Mines is now in the early stages of sinking a fourth, No. 7, shaft about 5,200 ft. south-east of No. 2 and just west of the upcast block of ore-bearing ground in the east-central section extending possibly to the eastern boundary, contiguous with President Brand lease area. A bore-hole in the block disclosed values of 614 in.–dwt. on an uncorrelated reef at 4,357 ft. just above the Basal Reef, which at 4,405 ft. disclosed 1,070 in.–dwt. The northern zone of the upcast block will be served by No. 2 shaft, to facilitate which a cross-cut is being advanced from the shaft area. The No. 7 shaft will be unequipped and will be sunk in two stages, the first to 4,100 ft. to serve the upcast block and in the second stage to about 6,000 ft. to serve the deeper workings from No. 2 shaft. The No 7 will be split to provide both upcast and downcast ventilation flow. The diameter is 22 ft. inside lining.

Development at Welkom Gold Mining has been initiated from the joint shaft system in the deeper south-western section, where the formations have been downcast by a major fault, but reef development results are not expected before the report for the period ending June 30. Results may conform to the lower limit of the bore-hole grade range. The Anglo American Corporation has renounced its option to acquire 1,258,000 Welkom reserve shares so that the company is faced with the problem of repaying or making arrangements for the repayment of its loan from Anglo American, as well as appropriating annual instalments from profits for redeeming outstanding debentures. In the immediate future the expansion of the milling rate will be facilitated by drawing tonnages from deeper workings in the Nos. 1 and 2 shaft areas and from the downcast south-western section. Additional ventilation in the No. 1 shaft area has been provided by the completion of a vertical ventilation winze sunk to a final depth of 1,726 ft. west of No. 1. Surface waste sorting, 7·17% in the 1958 year, is to be raised further to 12% of the tonnage to mill. The current milling rate is about 90,000 tons monthly, as compared with the capacity provided of 125,000–140,000.

Surface waste sorting at President Brand which has been raised to 12% of the tonnage to mill may rise further. To provide additional mill tonnage the mine is sinking its third shaft system, twin-circular units respectively (24 ft. diam. inside lining for hoisting and 20 ft. diam. ventilation), about 5,000 ft. from No. 1 shaft in the north-eastern section. The final depth will be about 5,000 ft. and the shaft system should be commissioned in 1961.

At President Steyn waste sorting has risen to about 13% and will be raised further to 15% of the tonnage to mill. Milling, which has been advanced to a little less than 100,000 tons monthly, will eventually be advanced further to 140,000. This expansion involves the sinking in the south-western section of a twin-shaft system, incorporating a hoisting unit of 26 ft. diam. inside lining and a ventilation unit of 20 ft. diam. i.l., which should be commissioned in 1962.

Western Holdings reports that two headings have reached the boundary at points between the two rich Geduld bore-holes and, more to the west, two other headings have been advanced nearer the boundary in the vicinity of the Geduld bore-hole in which 23,037 in.–dwt. was disclosed. Development is now proceeding in the central west section, where the third shaft system has been completed and commissioned. The gold plant capacity is being raised to the 150,000–170,000 tons-a-month range, the extensions to be completed before the mid-year, from which time a gradual build-up in the treatment rate will be effected beyond the present level of about 100,000 tons a month. Towards the year-end additional tonnages will become available from the No. 3 shaft area.

With the virtual completion of equipping the No. 2 shaft at Harmony capital expenditure has declined from £557,600 in the third to £457,900 in the final 1958 quarter. This shaft is already hoisting a total of 2,000 tons daily of ore and waste rock. The uranium plant has been extended to a capacity of 120,000 tons a month; the gold plant is being extended to 200,000 tons monthly and the pyrite flotation recovery plant to 120,000 tons monthly. Erection of the sulphuric acid plant is in progress.

Trade Notes

Brief descriptions of developments of interest to the mining engineer

New Self-Aligning Levels

A demonstration was given in London last month of two new surveying levels made respectively by **Cooke, Troughton, and Simms, Ltd.**, of York, and **Hilger and Watts, Ltd.**, of 98, St. Pancras Way, Camden Town, London, N.W. 1. The two companies concerned were able to announce at the same time that their technical and production staffs have collaborated in the design

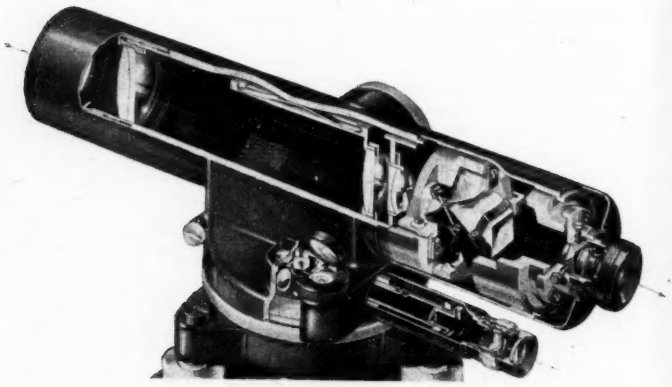


Fig. 1

and development of a novel and patented form of optical stabilizer which can be incorporated in the telescope of a surveyor's level in order to effect automatic compensation for any small errors in levelling. Thus the care which is necessary in setting up a conventional spirit-level instrument is no longer needed and much time and fatigue is saved. Once the instrument has been approximately levelled by means of the circular spirit vial the stabilizer sets the line of sight in a horizontal plane with precision, speed, and certainty.

This remarkable development, it is pointed out, means that the method of compensation does not depend upon any need to magnify mechanically the residual tilt of the instrument, but obtains the equivalent correction by purely optical means. It thus has advantages over other methods recently developed elsewhere. The moving part of this compensator carries two reflecting prisms and is suspended by four flexible metal strips forming a flexure-pivot. This type of pivot is particularly suitable for this purpose since it is frictionless yet robust ; it can be operated an infinite number of times and yet returns unfailingly to the correct position and it allows the compensator to come to rest in the vertical plane with a sensitivity of less than a second of arc in a fraction of a second of time. The flexible metal strips used in this pivot have a constant modulus of elasticity and they are so little stressed that the safety factor is given as 350/1. The total movement of the swinging part of the compensator is restricted to 20 minutes of arc by a damper which also serves to take the weight of the swinging prism mount when the instrument is in transit. Fig. 1 shows an interior view of the telescope.

The telescope is of the internal focusing type so constructed as to allow the stabilizer to be housed between the focusing lens and the reticule. It may be noted that by virtue of the prism system the observer sees an erect view of the measuring staff.

Each company has designed its own instrument around the common telescope and identical stabilizer unit, each having its own approach to the solution to the problems of the mechanical design (see Fig. 2). In general appearance, however, both instru-

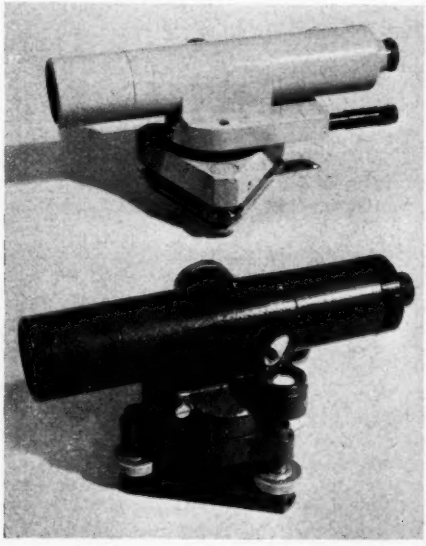


Fig. 2.—Above : S700 (Cooke, Troughton, and Simms) ; below Watts " Autoset ".

ments are not unlike a conventional surveyor's level. Each has a three-screw levelling base, circular bubble for preliminary levelling, azimuth clamp and tangent screw, and optional horizontal circle. Also a parallel plate micrometer attachment can be provided having a range of 0·02 ft. for measuring the interval between the reticule line and the nearest division of the staff directly to 0·001 ft.

Both companies have, it is understood, conducted extensive field trials to confirm that these instruments will give accurate results under all conditions, including wide variations of temperature. Between *minus* 30° C. to *plus* 50° C. the levels are consistently accurate. The ability of the stabilizer to withstand continuous vibration and bumping tests has also been investigated at length and all these tests have been passed. The experience gained shows that the use of these instruments doubles the speed of observation, reduces the risk of accidental error, and results in the saving of much time and fatigue. An accuracy of 0·02 ft. per mile is easily attained, while, by taking the usual care associated with double levelling, an average closing error per mile of 0·004 ft. is attainable.

The Hydroleg

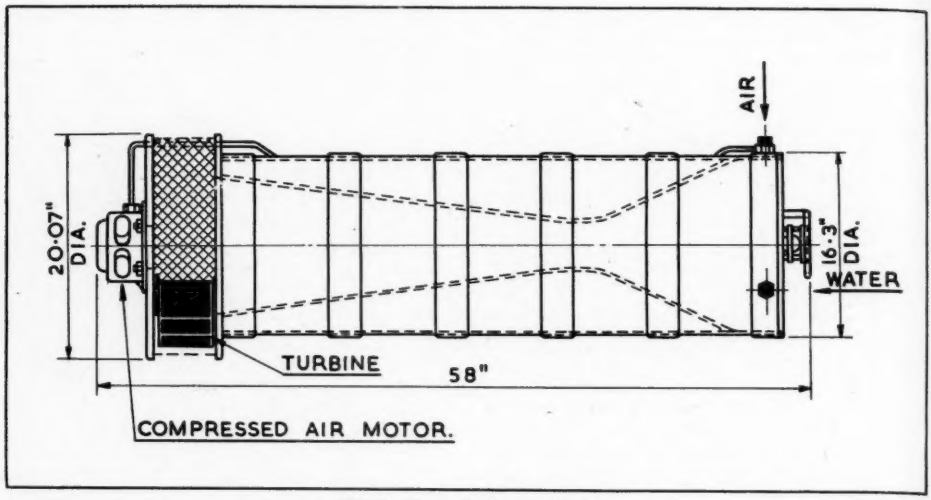
Air legs as feed supports for rock-drills are now used widely and they have contributed enormously in attaining the high-speed drilling rates that have nowadays become almost commonplace. It is now announced that **Holman Bros., Ltd.,** of Camborne, have widened the scope of this form of support still further by evolving the "Hydroleg" which functions in the same way but uses water pressure instead of compressed air. Where electric tools are used, it is pointed out, a compressed-air supply is not always provided but pressure water is usually available for dust control purposes and this supply is ideal for operating the Hydroleg. The design of the device follows closely that of the air leg, with the pressure hose being attached to a twist-grip valve mounted near the top end of the feed piston. It can be used when water under pressure from 60 to 150 lb./sq. in. is at hand. Two sizes are manufactured, providing a 39-in. and 52-in. length of feed respectively. The smaller unit weighs 29½ lb. and the larger 39 lb. Both sizes employ a 2-in. bore light-alloy cylinder and use ½-in. water hose. Drill

Hydroleg in Use.

mounts have been supplied to accommodate many types of electric and air-operated rotary drills. It is shown here in use at the rock face.

New Dust Collector

A light dust collector unit, for which high efficiency and large output is claimed, is now being manufactured in this country by **Austin Hopkinson and Co., Ltd.,** Delta Works, Audenshaw, Lancs. Known as the dust collector Type D.V.3, the plant was designed and tested in the research establishment (Cherchar) of the French nationalized industry. Making use of the Venturi principle the machine, illustrated here in cross-section, causes air carrying solid particles to be swept at high speed through the throat of a convergent-divergent Venturi by means of a jet of compressed air. An atomizer situated at the intake humidifies the air and a second atomizer unit incorporated with the first provides a fine water spray. The turbulence which occurs in the throat of the Venturi multiplies the number of encounters between the water and the dust particles, which increases the size of the particles and covers them with an aquaeous film. Such particles are subsequently trapped by



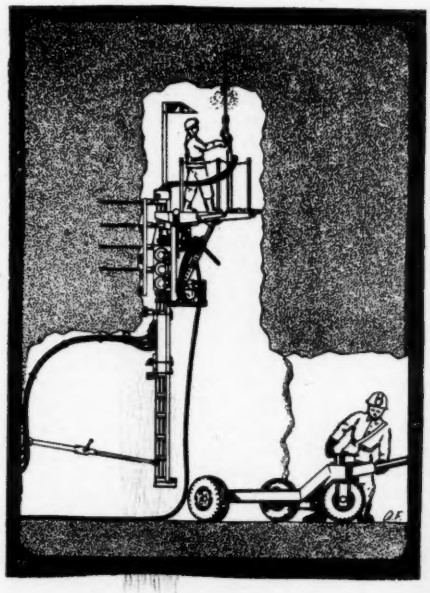
Light Dust Collector Unit.

a metal screen of fine mesh stainless steel. This is of circumferential form and rotated by a compressed-air motor at a speed of about 800 r.p.m. The high relative velocity between the air stream and the rotated screen affords excellent filtration of the water film created in the throat of the Venturi without creating mist or fog. In the device the casing and Venturi are of glass-fibre plastic, very light and extremely strong. The free air consumption of compressed air is given as 78 cu. ft. per min. and it displaces 2,500 cu. ft. of air a min. It weighs about 70 lb. and the water consumption is just over 2½ pints a min. at 70 lb. per sq. in.

Drilling Platform Elevator

New equipment for use in tunnelling and driving rises has recently been introduced by **A.C.E. Machinery, Ltd.,** of Brentford, Middlesex. This is a drilling platform elevator which is described in the maker's notes as follows : The elevator consists of a steel plate platform with a detachable protective bell on a standard ; the platform climbs a rack-equipped guide rail, driven by a compressed-air motor. The elevator in actual use was designed only for the driving of vertical rises, but the construction also permits driving inclined rises if the platform is hinged to the guide. The guide rails are mounted on the hanging-wall of the rise. The climbing speed of the elevator is about 35 ft./min., and the maximum permissible load on the platform is approximately 1,100 lb.

To drive a vertical rise an opening is first drilled and blasted in the roof of the tunnel, with the elevator still mounted on the transport trolley. At the same time a recess is blasted out of the rock where the elevator may be withdrawn when the charges are



fired during the driving of the shaft. The guide rail, 6 ft. in length, is next mounted on to the rock face with expansion bolts. To ensure that this lower section of guide rail shall sit squarely a concrete sole is cast behind it. When the concrete has set the driving of the rise may be undertaken.

The driller first runs the elevator to working height, drills the requisite number of holes, and puts in the charges, then returns the elevator to the bottom and swings it aside to safety. The charge is then fired by electric detonators or fast-burning fuses from a safe place on the tunnel floor. When the explosion gases have been expelled and the rock debris mucked out the elevator is again run to the working level. When travelling on the elevator, and when picking and scraping away loose stones from the work face after a round of blasting, the protective bell must always be mounted. After the roof has been cleared the next guide rail section can be mounted with expansion bolts and the miner can proceed to drill for the next charge. For the protection of the top end of the guide rail and the rack a special rail head box and cover are arranged over the guide rail top. When a rise has been completed expansion bolts and guide rails are easily removed to serve in the next rise to be driven.

Safety measures include a telephone and signal communication between the working platform and the tunnel floor. The platform is equipped with a tool box, special climbing irons, a grappling hook, and a life-line. With the help of this equipment the driller may climb down to the tunnel floor along the guide rails if the compressed-air supply fails. Climbing irons and grappling hooks should also be kept at the bottom opening of the rise. The platform can also be lowered by turning a hand crank.

Among many useful illustrations with which the text is amplified that reproduced here shows how the rock face is scraped clean and is then fitted out with a vertical timbered bed for the guide rail which is mounted by means of eight expansion bolts of a type and length suited to the rock material encountered. Air and water hoses are brought up to the connexions at the hinged part of the elevator and are attached to the tunnel roof so as not to be in the way of the elevator when it is swung in under the overhanging rock pentice. The carrier trolley may now be detached from the guide rail and wheeled away.

Personal

R. A. APPLEBY is here from Mexico.

E. J. D. BROWN has left for Sierra Leone.

E. C. CORBETT has been appointed a director of Consolidated African Mines, Ltd.

E. M. DAVEY has left for Nigeria.

A. R. C. FOWLER has been appointed a consulting engineer of Rand Mines, Ltd.

HENRY C. GUNNING has resigned as Dean of Engineering at the University of British Columbia to join the staff of the Anglo American Corporation in South Africa.

A. ROYDEN HARRISON, who succeeds H. G. MCKERROW as chief consulting engineer of the Anglo American Corporation of South Africa, Ltd., has been appointed a director of the corporation.

J. C. HILL has joined the staff of *Cement, Lime, and Gravel.*

JAMES HODGE has been appointed to the newly created post of chief engineer to the Holman Bros. Group.

J. E. HOLLOWAY, until recently South African High Commissioner in London, has been appointed part-time economic consultant to the Union Corporation, Ltd.

WILLIAM EWART HOSKING has been elected a director of Tekka, Ltd., and in succession to the late Mr. D. W. Thomas, also appointed chairman of Gopeng Consolidated, Rambutan, Tekka, and Pengkalen.

S. W. HYDE has been appointed works superintendent of the General Electric Co.'s Erith Works and F. J. BEESLEY works manager.

R. H. KERN is leaving Switzerland for the Belgian Congo.

M. A. E. MAWBY, Overseas Member of Council of the Institution of Mining and Metallurgy, has been awarded the C.B.E.

L. C. MILLETT has left for Ghana.

T. A. ROGERS is the new president of the Institution of Mining Engineers.

F. G. VOGWILL is home from Ghana.

J. B. WALL is returning from Tanganyika.

V. C. WANSBROUGH, of Toronto, vice-president and managing director of the Canadian Metal Mining Association, addressed the 46th annual meeting of the British Columbia and Yukon Chamber of Mines in Vancouver on January 13 on "The Mining Industry and Canada's Future."

R. G. WELLS is now in Australia.

P. WESTERBERG has left on a visit to East Africa.

DONALD WOODROFFE THOMAS, who died on January 20, was prominently associated with mining affairs both in Cornwall and Malaya. Chairman of the Board of Governors of the Camborne School of Metalliferous Mines, he had been connected with both the Cornish Chamber of Mines and with the Cornwall Mineral Development Association. Mr. Thomas was chairman of Tehidy Minerals, Ltd., and concerned with the direction of many Malayan tin companies.

GEORGE VIBERT DOUGLAS, who died in Toronto in October last, aged 66, was from 1932 to 1957 Carnegie Professor of Geology at Dalhousie University, Halifax. At McGill in 1914, he joined the

Forces in the following year and served with distinction in France, being awarded the Military Cross and mentioned in despatches. After the war he returned to McGill, which made him M.Sc. in 1921, after which he spent two years in the Antarctic as geologist to the Shackleton Expedition. Following post-graduate work at Cambridge and Harvard, Dr. Douglas was in 1926 appointed chief geologist to the Rio Tinto Company, remaining with that company until 1932, for a time working with Rhodesia Congo Border Concessions.

HECTOR RENNIE MACKILLIGIN, who died on December 21, was trained at the Camborne School of Mines. On leaving the School in 1902 he worked in the Sudan before going in 1905 to Western Australia. There he was engaged first at Lancefield and then at South Kalgurli. In 1911, however, Mr. Mackilligin went to West Africa, being engaged with Anfargah Gold Mines and then Prestea Block A. With the rising demand for wolfram in the 1914–18 war he left for Burma in 1916 and remained in that country until 1928, for the last six years as general manager of the Burma Bureau of Finance and Mining. Mr. Mackilligin returned home in the last-named year, going to Nigeria in 1929 to manage the Bisichi property. He was at Bisichi until 1937, in the following year being appointed manager of the Indian Copper Corporation, a position he held until 1945. Since then Mr. Mackilligin, who was a Member of the Institution of Mining and Metallurgy, had been interested in company affairs, for the past 10 years with the Kaduna Syndicate.

Metal Markets

During January [1]

Copper.—During January copper has advanced almost exactly £40 per ton in London,[2] while in the United States the primary producers, led by the custom smelters, have advanced from 29 cents per lb. to the central, and often controversial, figure of 30 cents per lb. Just at the moment this figure would seem to be a fair reflection of copper, but there are almost as many views on the outlook for the remainder of this year, and especially the next few months, as there are market observers.

Undoubtedly copper has been enabled to advance as far as it has in January by the fact that there is now definitely a better sentiment about the metal. The big Rhodesian strikes last year certainly helped to clear off some of the overwhelming surplus, even though it was revealed in the course of January that, as far as the R.S.T. group were concerned, and rather to the surprise of some people, their pipeline stocks were not wholly denuded (unlike those of International Nickel, strike-bound for three months last year). At the same time it is interesting to learn that, although the rate of output is being stepped up somewhat, the Rhodesian mines of the R.S.T. group are not expected to attain their target outputs in the financial year ending June 30, even though those targets represent a sizeable cut from 1956–57 performance. Inco copper figures are never very readily ascertained, but it appears that copper output there is being increased about the same third over the pre-strike rate as the nickel output.

These notes are a review of January, but it should be made clear that the net advance in prices over the month, mentioned at the outset, was helped by the threat of a strike at the Potrerillos mine in Chile in the closing days of the month. This was subsequently averted (the workers settling for a mere 30% increase in wages) and prices have receded somewhat. Another development late in the month was the news that further meetings are beginning to be held among fabricators of copper in Europe; one meeting has already been held in the U.K. It is not quite clear now, and especially since the demise of the R.S.T. price, what sort of pricing method is proposed, but, in the meantime, the Metal Exchange remains the origin of world market movements (although not, it should be stressed, the cause). A better and less volatile pricing system can undoubtedly be devised, but how it will work out in practice is another matter.

U.K. copper consumption in November was 60,219 tons, of which 47,932 tons was refined. Production was 7,627 tons primary refined and 8,604 tons secondary refined. There was a net decline in stocks in the month, although blister advanced to 20,231 tons. Refined stocks dropped to 48,792 tons.

Tin.—At long last it was learned in January that an agreement had been reached between the International Tin Council and the Russian authorities limiting Russian global exports of tin in 1959 to 13,500 tons. On the face of it this is an achievement, as this limit is less than the approximately 18,000 tons that were exported to all destinations in 1958. However, Russia has not agreed to join the Tin Agreement as a producing country and moreover has asked to be free to ship to what markets she likes. As a result the U.K. and other consumer member countries of the Agreement in Europe who imposed restrictions on Russian tin imports have now lifted them.

An idea that an agreement had been reached about the tonnage ultimately revealed by the official communique was current for several days beforehand, so that the market was able to adjust itself to the news slowly. Tin prices have definitely picked up during January [1] and in fact are currently at the highest level for well over a year; in the East London is being shown the way and prices are at the equivalent of £770 per ton. Granted a full maintenance of the current level of restriction of output and a continuance of present trends on the consumption side the Russian guarantee should mean that it is only a matter of time before prices reach £780 per ton, the level at which Buffer Stock holdings may be sold.

U.K. November consumption was 1,795 tons and production 2,526 tons. Stocks went down to 19,285 tons.

Lead.—United States quotas and United Nations stabilization talks have remained major topics of conversation in the lead world [1] in January. As was rather expected certain of the U.S. first-quarter 1959 quotas are filling up fairly rapidly—and that for "other countries" (which includes the U.K.) is full already. It may be expected therefore that rather more metal will be pushed on this side of the Atlantic—an increase which consumption is unlikely to absorb. The immediate situation could not, in

[1] Recent Prices, pp. 72, 112.
[2] See Table, p. 112.

[1] See Table, p. 112.

any case, be affected by the talks which began last year on the question of possible action to stabilize the lead and zinc markets by concerted producer-consumer action. Now, however, the possibility has been further removed by the fact that further talks scheduled for February 11, have been put off *sine die*. Perhaps by April there may be some point in the participants in the former talks coming together, but at present Canada and the U.S.A., to name but two, are completely at loggerheads.

U.K. November consumption was 28,786 tons and production 7,739 tons. Stocks dropped to 35,335 tons.

Zinc.—Three United States first-quarter quotas for zinc have already been filled—" Others," Belgo-Luxembourg, and Italy. London prices [1] are being somewhat supported by a stringency in g.o.b. metal supplies. There is, however, more than enough high-grade metal about which can always be debased so that there is no strong upward pressure on prices. On the U.N. talks, there is nothing to add to what has been said under lead.

U.K. November consumption was 26,432 tons and production 5,563 tons. There was a further drop in stocks to 35,396 tons.

Iron and Steel.—The U.K. iron and steel industry has, after the experiences of 1958, entered 1959 in a somewhat chastened mood. Although it had been prepared for a fall in demand last year, the duration of consumer destocking was a complete surprise ; output, which was expected to remain about steady, actually declined by 11½%. The steel industry is thus very cautious about 1959 prospects. Its raw material plans are based on an output of 20,000,000 tons of raw steel (output in 1958 was 19,570,000 tons), but production could be increased should the demand arise.

The new year has, in fact, opened quietly. Production in the industry is running, on an average, at 75% of capacity and although there are no real signs of any marked improvement in conditions neither has there been any deterioration. Demand for the heavier products—such as sections and plates—is subdued, but the strip-mills rolling sheets for the motor industry continue to enjoy boom conditions and narrow strip is also in keen request. Over the past few months tinplate demand has picked up and last year's exports, despite a highly competitive market, were a shade above those in 1957. Tinplate producers will meet with even more serious competition this year, however. World capacity is increasing and countries not previously producers are entering the field.

The Government has already taken measures to stimulate the economy and these have begun to make themselves felt in the light sections of the steel industry and by the middle of the year it is hoped that they will be reflected in steel operations generally.

Iron Ore.—In view of the decline in steel production last year it was not surprising that iron ore imports into the U.K. went down. They fell actually by 19%—from 15,912,303 tons to 12,912,700 tons.

Aluminium.—January was a dull month as far as aluminium was concerned, the only interesting item of news, now history, being that Reynolds-T.I. won the battle for control of British Aluminium. Before the middle of the month it was announced that Reynolds-T.I. held 87½% of B.A.'s ordinary shares. When this fact became known Alcoa dropped out of the running and the merchant banks backing the B.A. board released stockholders who had accepted their offer from the provision that they must not sell the remainder of their shares. Treasury consent for the deal was granted on the understanding that control of B.A. remains in this country.

Towards the end of the month an event occurred which may throw some light on the question on how the big companies might act when asked to sell metal to communist countries. A Canadian Government inquiry is to be held to discover whether any foreign influences were brought to bear on Alcan, which recently decided not to undertake an export contract with China. According to reports from Canada an export licence for 2,200 tons of aluminium, valued at something like $1,000,000, was granted, although a Vancouver export concern complained that the deal had not been allowed to proceed. In protesting against the rumours of foreign pressure being brought to bear, Alcan said . . . " we would be derelict in our duty if we followed a shortsighted policy for immediate gain to the eventual disadvantage of our business . . ." Whether or not this sentiment will assist Alcan to sell any more metal in other markets remains to be seen. However, this incident does show that China is a keen buyer of aluminium, despite its earlier apparent eagerness to sell.

Ingots in the United Kingdom are still quoted at £180 a ton.

Antimony.—Activity in this market during January was no more noticeable than in previous months, although a somewhat firmer tendency in the price of Chinese material was discernible ; 99·6% material is now quoted at £137–£141 a ton and 99% Chinese at £132–£136. English 99·6 regulus is still quoted at £197 10s. a ton.

Arsenic.—Nothing of interest characterized this market during January and prices of both metal and trioxide remained unchanged at £400 and £40–£45 a ton, respectively. Arsenic trioxide imports during 1958 totalled 6,891 tons, as compared with 3,294 tons in 1957.

Bismuth.—There has been no alteration in the position of bismuth and it is still quoted nominally at 16s. per lb. Imports into the U.K. during 1958 totalled 914,870 lb., as compared with 950,490 lb. in 1957.

Cobalt.—The overall cobalt picture remains unaltered, with, it seems, little chance of any improvement in the near future. Unless there is some startling new application found for this metal quite soon it seems that things will go from bad to worse. Latest news is that the price in the U.K. has been reduced ; metal is now quoted at 14s. per lb., black oxide at 9s. 1d. per lb., and grey oxide at 9s. 8d. per lb.

Imports during 1958 were well below those of the previous year. Last year's imports totalled only 1,584,090 lb., against 2,538,230 lb. in 1957.

Cadmium.—This market has not moved from the previous level of 9s. 6d. per lb. for both U.K. and imported metal. U.K. consumption during the first eleven months of 1958 amounted to 932 tons, however—an increase over consumption in the same period of 1957 (878 tons).

Chromium.—No moves have occurred in this normally quiet and unexciting market and the price of chromium metal is still quoted at 6s. 11d.–7s. 4d. per lb.

[1] See Table, p. 112.

Tantalum.—Despite the note in the last report to the effect that many consumers are lowering their sights as far as content is concerned and appear to be thinking more in terms of 45–50% material, in the absence of any clarification of the position 60% material is still quoted as a basis. This grade is quoted, as it was in December last year, at 800s.–850s. per unit.

Platinum.—Metal on the open market is easier and is now quoted at £17 5s.–£18 per troy oz.; however, leading sellers of U.K. and Empire metal continue to quote £19 10s. in a very slow market. Business is virtually non-existent, with no real prospects of any immediate pick-up in view.

Iridium.—There has been no change in the position of this metal since the last report and it is still nominally quotable at £19–£21 per troy oz.

Osmium.—Much the same comments apply to osmium as to the other platinum-group metals and the price remains at £16–£17 per troy oz.

Palladium.—As has been the case for some months the palladium market remained featureless in January, with the price continuing to be quoted at £5–£5 15s. per troy oz.

Imports of platinum-group metals into the United Kingdom during 1958 totalled 147,141 troy oz., as compared with 280,735 oz. in the previous year.

Tellurium.—This metal is still quoted at 15s.–16s. per lb. and no alteration to the general market outlook was noted during January.

Tungsten.—During January the general tone of the wolfram market was a weak one and there do not seem to be any signs of an early recovery in this ore. Producers' stocks are still high and are getting, it would seem, higher and although there is a modest volume of demand it is nothing like enough to make any great impression on these stocks.

The price is currently quoted at 90s.–95s. per long ton unit of WO_3.

Nickel.—Following the news of the ending of the Inco strike there is nothing fresh to report on this metal. The metal in the U.K. is still quoted at £600 a ton.

Chromium.—Effective from January 1 a further reduction of 7s. 6d. a ton was made in liner freights from Beira and Lourenco Marques. As yet there have not been parallel reductions in chrome ore prices, although these are expected in the near future.

Metallurgical grade 48% ore continues to be quoted at £15 15s. per ton.

Molybdenum.—Following the increase in the ore price, which was noted in the last report, ferro-molybdenum, etc., have all been increased in price.

Molybdenum concentrates are still quoted at 8s. 11d. per lb. of metal contained.

Manganese.—During January keen interest was evinced by observers of the manganese-ore market in the progress of the talks between the U.K. and Egypt. Throughout 1958 U.K. consumers have not been able to buy Egyptian manganese dioxide or ore and while it would not be correct to say that there has been a dearth of the 87–90% dioxide, it is true to say that since Suez trade in this grade of material has been much less straightforward.

Prospects for Indian ore did not improve during the month and 46–48% material is quoted still at 77d.

Tin, Copper, Lead, and Zinc Markets

Tin, minimum 99·75%; Copper, electro; Lead, minimum 99·75%; and Zinc, minimum 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Jan. 9	757 0	757 15	224 10	223 7½	72 13¾	72 13¾	75 12½	73 2½
12	758 0	758 15	228 7½	226 12½	72 11¼	72 16¼	76 2½	73 7½
13	756 10	756 15	229 15	227 12½	72 8¾	72 12½	76 7½	73 17½
14	756 0	756 15	231 7½	228 2½	72 1¼	72 7½	76 6¼	73 11¼
15	756 10	757 5	229 2½	226 2½	70 2½	71 11¼	75 7½	73 7½
16	758 0	758 15	231 12½	227 12½	71 11¼	71 17½	75 18¾	73 12½
19	761 0	760 10	230 17½	227 12½	71 12½	71 18¾	75 7½	73 6¼
20	763 0	763 5	228 12½	225 12½	71 7½	71 12½	75 2½	73 2½
21	763 10	762 15	230 7½	227 7½	71 13¾	71 18¾	74 16¼	73 7½
22	765 0	762 5	231 7½	227 17½	71 1¼	71 6¼	74 10	73 2½
23	763 0	761 10	230 12½	227 2½	70 6¼	70 16¼	72 17½	71 17½
26	762 0	761 15	234 7½	229 17½	70 18¾	71 6¼	72 12½	71 7½
27	763 10	763 0	238 5	233 7½	71 7½	71 18¾	73 2½	72 1¼
28	765 0	764 5	239 15	234 5	70 18¾	71 13¾	73 12½	72 2½
29	766 0	765 5	240 7½	235 2½	71 1¼	71 16¼	73 11¼	72 6¼
30	767 0	766 10	241 12½	237 5	70 18¾	71 16¼	73 7½	72 7½
Feb. 2	767 0	766 5	237 10	233 5	70 17½	71 7½	72 8¾	71 7½
3	768 0	767 5	236 17½	233 12½	70 8¾	70 18¾	71 17½	70 17½
4	768 10	768 15	235 2½	232 7½	72 6¼	71 2½	70 13¾	71 3¾
5	771 0	771 10	231 2½	230 2½	70 3¾	70 16¼	72 0	70 17½
6	771 10	772 0	232 15	232 5	70 13¾	71 3¾	72 16¼	71 11¼
9	773 10	773 5	232 2½	232 7½	70 11¼	71 3¾	73 2½	71 16¼
10	772 0	771 15	230 12½	230 12½	69 17½	70 7½	72 2½	70 13¾

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	December		January	
	Treated Tons.	Yield Oz.*	Treated Tons.	Yield Oz.†
Blyvooruitzicht	105,000	69,147	106,000	69,704
Brakpan	130,000	16,759	140,000	16,500
Buffelsfontein‡	122,000	41,364	122,000	41,674
City Deep	113,000	23,662	117,000	24,446
Cons. Main Reef	121,000	20,028	118,000	20,116
Crown Mines	220,000	34,393	232,000	35,826
Daggafontein	230,000	47,197	227,000	46,426
Doornfontein‡	87,000	36,562	88,000	36,520
D'rb'n Roodepoort Deep	185,000	33,651	190,000	34,694
East Champ D'Or‡	12,000	329	12,000	284
East Daggafontein	91,000	15,093	91,000	15,110
East Geduld	130,000	39,974	137,000	42,141
East Rand P.M.	207,000	54,053	223,000	57,169
Eastern Transvaal Consol	19,000	6,281	19,000	6,283
Ellaton‡	31,000	7,252	30,000	7,079
Freddies Consol.	54,000	13,946	57,000	13,754
Free State Geduld	72,000	54,554	73,000	55,663
Geduld	72,000	12,680	72,000	12,790
Government G.M. Areas‡	60,000	10,662	64,000	10,958
Grootvlei Proprietary	195,000	41,436	205,000	43,451
Harmony Gold Mining	103,000	42,032	112,000	44,802
Hartebeestfontein‡	87,000	47,850	86,000	46,870
Libanon	98,000	23,198	98,000	23,220
Loraine	75,000	14,625	73,000	14,418
Luipaards Vlei‡	120,000	13,645	120,000	13,776
Marievale Consolidated	84,000	21,632	90,000	22,857
Merriespruit‡	—	—	—	—
Modderfontein East	129,000	13,043	141,000	13,541
New Kleinfontein	81,000	10,673	84,000	11,004
New Klerksdorp‡	10,300	1,117	8,900	988
President Brand	96,000	72,547	95,000	72,418
President Steyn	82,500	32,157	94,000	36,566
Rand Leases	181,000	26,245	181,000	26,698
Randfontein‡	162,000	11,754	189,000	13,257
Rietfontein Consolid't'd.	18,000	4,553	16,000	4,348
Robinson Deep	67,000	13,170	66,000	14,110
Rose Deep	34,000	4,614	38,000	5,619
St. Helena Gold Mines	139,000	40,057	140,000	40,741
Simmer and Jack	90,000	17,023	90,000	17,200
S. African Land and Ex.	91,000	19,058	90,000	18,935
S. Roodepoort M.R.	29,000	7,019	31,000	7,440
Spaarwater Gold	10,500	3,285	10,700	3,314
Springs	108,000	14,589	104,000	14,220
Stilfontein Gold Mining‡	125,000	63,849	125,000	63,875
Sub Nigel	66,250	15,893	66,500	15,907
Transvaal G.M. Estates	8,500	1,850	7,700	1,907
Vaal Reefs‡	78,000	35,567	78,000	35,491
Van Dyk Consolidated	74,000	13,503	78,000	14,695
Venterspost Gold	119,000	30,488	123,000	31,279
Village Main Reef	27,000	4,863	27,000	4,895
Virginia O.F.S.‡	114,000	29,080	114,000	29,070
Vlakfontein	49,500	17,721	50,000	17,929
Vogelstruisbult‡	92,000	20,608	90,000	20,610
Welkom Gold Mining	89,500	27,154	90,000	27,482
West Dreifontein‡	81,000	77,520	82,000	78,319
West Rand Consol.‡	208,000	20,966	206,000	20,893
Western Holdings	96,000	57,600	100,000	60,001
Western Reefs	109,000	27,363	110,000	29,051
Winkelhaak	69,000	15,498	71,000	16,245
Witwatersrand Nigel	18,000	4,355	18,100	4,374

† 249s. 7d. * 249s. 9d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
Dec.,* 1957	16,198,500	64 4	46 1	18 3	23,695,380
Jan., 1958.	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.*	15,806,300	64 10	46 6	18 4	23,170,987
April	—	—	—	—	—
May	—	—	—	—	—
June*	16,435,500	64 9	46 6	18 3	24,358,945
July	—	—	—	—	—
August	—	—	—	—	—
Sept.*	16,760,400	65 10	46 9	19 1	25,633,898
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	—	—	—	—	25,934,441

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
January, 1958	1,377,505	40,534	1,418,039
February	1,322,843	33,879	1,356,722
March	1,394,956	36,330	1,431,286
April	1,401,094	38,352	1,439,446
May	1,435,960	36,494	1,472,454
June	1,408,384	39,187	1,447,571
July	1,456,925	42,312	1,499,237
August	1,463,259	36,413	1,499,672
September	1,465,697	36,799	1,502,496
October	1,516,701	44,025	1,560,726
November	1,484,844	32,349	1,517,193
December	1,480,525	40,372	1,520,897

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
April 30, 1958	337,284	31,424	368,708
May 31	337,464	31,509	368,973
June 30	334,882	31,336	366,218
July 31	336,356	31,608	367,964
August 31	334,815	31,924	366,739
September 30	333,380	31,978	365,358
October 31	335,003	32,657	367,660
November 30	332,443	32,851	365,294
December 31	329,234	32,946	362,180

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To Jan. 14		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	31,000‡	4,718	5,994
Electrolytic Zinc	12,221	563	3,643
Lake George	—	—	—
Mount Isa Mines**	68,778	4,700†	1,789
New Broken Hill	61,366‡	9,974	15,074
North Broken Hill	34,703‡	6,316	6,858
Zinc Corp.	82,314‡	13,710	14,558
Rhodesia Broken Hill*	—	3,050†	7,700†

* 3 Mths. ** Copper 2,840 tons. † Metal. ‡ 6 weeks to Dec. 31.

RHODESIAN GOLD OUTPUTS

	December		January	
	Tons	Oz.	Tons	Oz.
Cam and Motor	31,602	—	31,853	—
Falcon Mines	20,000	3,749	20,000	3,732
Globe and Phœnix	5,550	3,431	—	—
Motapa Gold Mining	18,100	1,910	19,200	1,844
Mazoe	2,903	—	2,678	—
Coronation Syndicate	11,802	—	12,016	—
Phœnix Prince*	40,930	3,641	—	—

* 3 Months.

WEST AFRICAN GOLD OUTPUTS

	December		January	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	61,020	14,696	61,769	14,775
Ariston Gold Mines	37,355	2,463	39,000	12,198
Ashanti Goldfields	33,750	25,550	—	—
Bibiani	35,000	7,200	—	—
Bremang	—	4,350	—	4,528
Ghana Main Reef	11,685	4,454	11,430	4,492
Konongo	6,450	3,741	6,330	3,746
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1957		1958	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,337	6,134	44,305	46,553
February	41,607	5,697	43,591	21,313
March	43,831	8,179	43,830	8,179
April	46,754	6,854	46,587	22,573
May	42,650	5,606	46,015	19,937
June	46,682	6,441	46,453	20,105
July	41,922	5,781	44,244	19,170
August	44,001	5,897	47,484	20,549
September	45,762	5,677	48,295	21,141
October	46,838	5,570	46,311	6,342
November	46,987	6,331	47,904	16,435
December	45,479	5,814	48,888	30,724

WESTRALIAN GOLD PRODUCTION

	1956	1957	1958
	Oz.	Oz.	Oz.
January	66,388	106,722	66,562
February	94,638	64,949	65,965
March	66,944	67,121	65,420
April	60,415	66,435	60,855
May	62,294	64,886	64,196
June	63,570	65,142	67,929
July	69,883	74,420	81,106
August	72,303	75,727	68,610
September	62,204	64,422	68,744
October	64,594	64,524	70,128
November	64,113	65,700	67,562
December	65,031	66,562	120,106
Total	812,377	846,610	867,187

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To Dec. 23		To Jan. 20	
	Tons	Oz.	Tons	Oz.
Central Norseman	14,059	8,429	14,056	6,894
Crœsus Proprietary	—	—	—	—
Gold Mines of Kalgoorlie	39,664	9,307	36,758	9,300
Golden Horse Shoe*	—	—	—	—
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	35,660	5,938	32,216	6,557
Hill 50*	—	—	—	—
Kalgurli Ore Treatment	—	—	—	—
Lake View and Star*	179,382	40,840	—	—
Moonlight Wiluna*	—	—	—	—
Morning Star (G.M.A.)	1,272	709	1,003	381
Mount Ida*	—	—	—	—
New Coolgardie	—	—	—	—
North Kalgurli	26,805	7,131	27,100	5,374
Sons of Gwalia	13,674	2,950	—	—
Mount Morgan	—	5,498	—	5,783

* 3 Months.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
August, 1957	701,174	192,453	31,647	6,410,429
September	722,384	165,471	34,248	6,947,813
October	772,383	224,217	37,086	7,657,426
November	756,494	219,352	37,737	7,441,702
December	750,537	215,462	44,230	7,494,289
January, 1958	779,128	219,502	31,562	7,462,598
February	727,170	210,646	35,370	7,248,333
March	807,458	229,361	38,323	7,873,264
April	785,264	228,590	35,712	7,789,644
May	801,102	228,123	37,535	7,745,425
June	775,384	228,960	42,275	7,740,144
July	750,410	218,126	38,940	7,355,406
August	740,459	202,798	31,543	7,006,517
September	771,115	209,006	34,914	7,178,218
October	801,965	230,251	35,097	7,842,435
November	783,065	219,351	30,980	7,490,094

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	Dec.		Jan.	
	Tons	Oz.	Tons	Oz.
British Guiana Cons.	—	—	—	—
Central Victoria Dredging	—	—	—	—
Clutha River	—	460	—	—
Emperor Mines (Fiji)*	—	—	—	—
Frontino Gold (Colombia)	—	—	—	—
Geita Gold (Tanganyika)	—	—	—	—
Harrietville (Aust.)	—	—	—	—
Lampa (Peru)†	—	42,966	—	37,887
Loloma (Fiji)*	—	—	—	—
New Guinea Goldfields	—	2,120	4,333	1,168
St. John d'el Rey (Brazil)	—	—	—	—
Yukon Consol.	—	—	—	—

* 3 Months. † Oz. Silver : Copper, 111 : 67 tons.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	Nov.	Dec.	Jan.
Ampat Tin	77	66	—
Austral Amalgamated	—	—	—
Ayer Hitam	—	132*	—
Batu Selangor	—	—	—
Berjuntai	146	136½	—
Chenderiang	—	19*	—
Gopeng Consolidated	—	92*	—
Hongkong Tin	—	—	—
Idris Hydraulic	—	26*	—
Ipoh	—	47*	—
Jelapang Tin	—	—	—
Kampong Lanjut	31	37	—
Kamunting	96	95	—
Kent (F.M.S.)	—	35*	—
Kepong	—	—	—
Killinghall	—	47*	—
Kinta Kellas	—	—	—
Kinta Tin Mines	—	52*	—
Klang River	—	—	—
Kramat	64	47	—
Kuala Kampar	49	87	—
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	—	—	—
Lower Perak	42	48½	—
Malayan	—	266*	—
Malaysiam	5½	—	—
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	—	37½*	—
Pengkalen	—	51*	—
Petaling Tin	—	228½	—
Puket	—	—	—
Rahman Hydraulic	—	60*	—
Rambutan	—	20½*	—
Rantau	33	30½	—
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	—	113*	—
Selayang	—	39	—
Siamese Tin Syndicate (Malaya)	25	12	13
Southern Kinta	291	328	—
Southern Malayan	—	416*	—
Southern Tronoh	—	—	—
Sungei Besi	—	144*	—
Sungei Kinta	—	35*	—
Sungei Way	—	183*	—
Taiping Consolidated	31	21	—
Tambah	—	—	—
Tanjong	—	115*	—
Tekka	—	17*	—
Tekka-Taiping	—	—	—
Temoh	—	124½*	—
Tongkah Compound	—	—	—
Tongkah Harbour	32	29	—
Tronoh	—	400†	—
Ulu Klang	—	—	—

* 3 months. † Grouped Quota.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	December		January	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines	182	27	—	—
Anglo-Burma Tin *	51	—	—	—
Bangrin	22	—	63	—
Beralt	44	125†	45	131†
Bisichi	42½	2	43½	6
Ex-Lands Nigeria	30	—	40	—
Geevor	57	—	62	—
Gold and Base Metal	27	2½	30	1
Jantar Nigeria	10	16	—	—
Jos Tin	7½	—	—	—
Kaduna Prospectors	3	—	4	—
Kaduna Syndicate	12½	—	15	—
Katu Tin	—	—	13	—
Kelfi Tin	—	—	—	—
London Nigerian Mines	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	6	—	4½	—
Naraguta Karama	5	—	5½	—
Naraguta Tin	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria)	8	—	—	—
Siamese Tin Syndicate	—	—	15	—
South Bukeru	—	—	—	—
South Crofty	72	—	81	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	3	—	—	—

* 3 months. † Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

November, 1958.

Gold	1,522,127 oz.
Silver	163,815 oz.
Diamonds	260,490 carats.*
Coal	3,287,218 tons.
Copper	(*a*) 86 tons in matte and copper-gold concentrates. (*b*) 4,280 tons of 99·28%.
Tin	243 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	13,523 tons.
Chrome Ore	57,529 tons.
Manganese Ore	82,176 tons.
Lead Concs.	7 tons.

* Oct., 1958.

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		November	December
Iron Ore	tons	918,095	987,183
Manganese Ore	,,	17,266	29,165
Iron and Steel	,,	31,993	31,596
Iron Pyrites	,,	16,733	16,546
Copper Metal	,,	32,298	38,200
Tin Ore	,,	5,329	5,790
Tin Metal	,,	801	317
Lead	,,	9,815	23,248
Zinc Ore and Conc.	,,	26,969	7,099
Zinc	,,	9,439	13,753
Tungsten Ores	,,	306	549
Chrome Ore	,,	18,312	7,053
Bauxite	,,	43,000	17,550
Antimony Ore and Concs.	,,	1,364	1,159
Titanium Ore	,,	27,760	18,306
Nickel Ore	,,	—	—
Tantalite/Columbite	,,	26	83
Sulphur	,,	23,013	31,041
Barytes	,,	3,262	3,308
Asbestos	,,	13,745	12,692
Magnesite	,,	768	1,066
Mica	,,	408	300
Graphite	,,	256	520
Mineral Phosphates	,,	72,402	122,595
Molybdenum Ore	,,	165	320
Nickel	cwt.	6,051	5,982
Aluminium	,,	381,105	370,213
Mercury	lb.	95,044	90,186
Bismuth	,,	66,205	88,370
Cadmium	,,	159,569	218,484
Cobalt and Cobalt Alloys	,,	123,512	58,019
Selenium	,,	3,265	7,821
Petroleum Motor Spirit	1,000 gals.	42,739	69,071
Crude	,,	782,974	871,118

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	106	0	0
,, ,, 80% Technical	,,	97	0	0
Alum, Comml.	,,	25	0	0
Aluminium Sulphate	,,	16	10	0
Ammonia, Anhydrous	per lb.		2	0
Ammonium Carbonate	per ton	59	0	0
,, Chloride, 98%	,,	26	0	0
,, Phosphate (Mono- and Di-)	,,	102	0	0
Antimony Sulphide, golden	per lb.		3	0
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate (native), 94%	,,	Nominal		
,, Chloride	,,	53	0	0
Barytes (Bleached)	,,	20	0	0
Benzene	per gal.		5	2
Bleaching Powder, 36% Cl.	per ton	30	7	6
Borax	,,	44	0	0
Boric Acid, Comml.	,,	75	10	0
Calcium Carbide	,,	40	17	9
,, Chloride, solid, 70/75%	,,	13	5	0
Carbolic Acid, crystals	per lb.		1	6
Carbon Bisulphide	per ton	62	10	0
Chromic Acid (ton lots)	per lb.		2	1½
Citric Acid	per cwt.	11	0	0
Copper Sulphate	per ton	74	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	2
Cresylic Acid, refined	,,		6	10
Hydrochloric Acid 28° Tw.	per carboy		13	0
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iron Sulphate	per ton	3	17	6
Lead, Acetate, white	,,	124	0	0
,, Nitrate	,,	116	0	0
,, Oxide, Litharge	,,	106	5	0
,, Red	,,	104	5	0
,, White	,,	116	0	0
Lime Acetate, brown	,,	40	0	0
Magnesite, Calcined	,,	20	0	0
,, Raw	,,	9	0	0
Magnesium Chloride, ex Wharf	,,	16	0	0
,, Sulphate, Comml.	,,	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.		6	3
Nitric Acid, 80° Tw.	per ton	37	10	0
Oxalic Acid	,,	129	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Pine Oil	per ton	Nominal		
Potassium Bichromate	per lb.		1	2½
,, Carbonate (hydrated)	per ton	74	10	0
,, Chloride	,,	21	0	0
,, Iodide	per lb.		7	3
,, Amyl Xanthate	,,	Nominal		
,, Ethyl Xanthate	,,	Nominal		
,, Hydrate (Caustic) flake	per ton	118	0	0
,, Nitrate	per cwt.	4	1	0
,, Permanganate	per ton	193	10	0
,, Sulphate, 50%	,,	20	13	0
Sodium Acetate	,,	99	0	0
,, Arsenate, 58–60%	,,	Nominal		
,, Bicarbonate	,,	15	0	0
,, Bichromate	per lb.		1	0
,, Carbonate (crystals)	per ton	Nominal		
,, ,, (Soda Ash) 58%	,,	13	15	0
,, Chlorate	,,	91	0	0
,, Cyanide 100% NaCN basis	per cwt.	6	6	6
,, Hydrate, 76/77%, solid	per ton	33	0	0
,, Hyposulphite, Comml.	,,	32	15	0
,, Nitrate, Comml.	,,	29	0	0
,, Phosphate (Dibasic)	,,	40	10	0
,, Prussiate	per lb.		1	0½
,, Silicate	per ton	11	0	0
,, Sulphate (Glauber's Salt)	,,	9	15	0
,, ,, (Salt-Cake)	,,	10	0	0
,, Sulphide, flakes, 60/62%	,,	38	12	6
,, Sulphite, Comml.	,,	27	10	0
Sulphur, American, Rock (Truckload)	,,	15	0	0
,, Ground, Crude	,,	17	10	0
Sulphuric Acid, 168° Tw.	,,	10	10	0
,, ,, free from Arsenic, 140° Tw.	,,	8	0	0
Superphosphate of Lime, 18% P_2O_5	,,	14	18	6
Tin Oxide	,,	Nominal		
Titanium Oxide, Rutile	,,	172	0	0
,, White, 25%	,,	85	0	0
Zinc Chloride	,,	95	0	0
,, Dust, 95/97% (4-ton lots)	,,	109	0	0
,, Oxide	,,	95	10	0
,, Sulphate	,,	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	Jan. 8, 1959 £ s. d.	Feb. 10, 1959 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	2 19 3	3 14 3
Blyvooruitzicht (2s. 6d.)	1 4 0	1 3 0
Brakpan (5s.)	4 9	5 0
Buffelsfontein (10s.)	2 6 6	2 7 3
City Deep	16 0	16 6
Consolidated Main Reef	17 6	17 3
Crown Mines (10s.)	1 5 9	1 6 0
Daggafontein (5s.)	1 12 3	1 9 0
Dominion Reefs (5s.)	15 9	15 0
Doornfontein (10s.)	1 10 6	1 10 9
Durban Roodepoort Deep (10s.)	1 11 6	1 13 0
East Champ d'Or (2s. 6d.)	2 0	2 0
East Daggafontein (10s.)	8 9	8 6
East Geduld (4s.)	1 4 6	1 3 6
East Rand Ext. (5s.)	1 9 0	1 7 6
East Rand Proprietary (10s.)	2 4 0	2 3 0
Freddies Consol.	2 6	3 3
Free State Dev. (5s.)	8 3	9 9
Free State Geduld (5s.)	5 11 9	7 4 3
Free State Saaiplaas (10s.)	16 9	18 0
Geduld	3 3 0	3 5 0
Government Gold Mining Areas (4s.)	4 3	4 3
Grootvlei (5s.)	17 3	17 6
Harmony (5s.)	1 18 3	2 3 9
Hartebeestfontein (10s.)	3 5 6	3 3 6
Libanon (10s.)	9 3	9 3
Loraine (10s.)	1 4 0	1 14 9
Luipaards Vlei (2s.)	9 6	9 3
Marievale (10s.)	1 4 0	1 5 3
Merriespruit (5s.)	7 0	7 6
Modderfontein B (3s.)	2 6	2 3
Modderfontein East	13 9	14 9
New Kleinfontein	4 3	4 9
New Pioneer (5s.)	2 1 9	2 0 6
New State Areas (15s. 6d.)	2 3	2 0
President Brand (5s.)	3 6 3	3 8 3
President Steyn (5s.)	1 11 3	1 14 9
Rand Leases (10s.)	6 9	6 9
Randfontein	1 5 6	1 5 3
Rietfontein (4s.)	7 3	7 3
Robinson Deep (6s.)	8 0	8 9
Rose Deep (6s. 6d.)	13 0	12 9
St. Helena (10s.)	2 9 3	2 19 0
Simmer and Jack (2s.)	3 3	3 3
South African Land (3s. 6d.)	1 1 9	1 1 0
Springs (5s.)	1 9	1 9
Stilfontein (5s.)	2 5 0	2 7 9
Sub Nigel (10s.)	15 6	15 3
Vaal Reefs (5s.)	1 19 6	1 19 9
Van Dyk (7s. 9d.)	4 3	4 3
Venterspost (10s.)	16 0	16 3
Virginia (5s.)	9 0	9 0
Vlakfontein (10s.)	17 9	18 3
Vogelstruisbult (10s.)	8 9	8 6
Welkom (5s.)	18 9	1 0 6
West Driefontein (10s.)	5 18 9	5 14 3
West Rand Consolidated (10s.)	1 5 9	1 5 6
West Witwatersrand Areas (2s. 6d.)	2 13 3	3 13 3
Western Holdings (5s.)	5 19 3	6 15 0
Western Reefs (5s.)	1 8 9	1 11 0
Winkelhaak (10s.)	19 9	1 1 3
Witwatersrand Nigel (2s. 6d.)	1 3	1 3
Zandpan (10s.)	—	19 9
RHODESIA:		
Cam and Motor (2s. 6d.)	8 0	8 0
Chicago-Gaika (10s.)	16 3	15 0
Coronation (2s. 6d.)	4 3	4 3
Falcon (5s.)	7 6	7 6
Globe and Phœnix (5s.)	1 9 0	1 10 6
Motapa (5s.)	4½	9
GOLD COAST:		
Amalgamated Banket (3s.)	1 0	1 2
Ariston Gold (2s. 6d.)	4 6	5 0
Ashanti Goldfields (4s.)	18 0	18 0
Bibiani (4s.)	2 6	2 6
Bremang Gold Dredging (5s.)	1 6	1 7
Ghana Main Reef (5s.)	1 9	2 3
Konongo (2s.)	1 9	1 9
Kwahu (2s.)	2 9	3 6
Western Selection (5s.)	4 6	5 6
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	2 0	2 0
Gold Mines of Kalgoorlie (10s.)	8 6	8 3
Great Boulder Propriet'y (2s.), W.A.	12 3	12 9
Lake View and Star (4s.), W.A.	1 3 9	1 4 0
London-Australian (2s.)	9	9
Mount Morgan (10s.), Q.	12 0	13 3
New Guinea Gold (4s. 3d.)	2 0	2 0
North Kalgurli (1912) (2s.), W.A.	10 3	10 6
Sons of Gwalia (10s.), W.A.	2 0	2 9
Western Mining (5s.), W.A.	10 9	10 0

	Jan. 8, 1959 £ s. d.	Feb. 10, 1959 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	1 13 9	1 15 0
Kentan Gold Areas	—	2 1 9
St. John d'el Rey, Brazil	3 10 0	4 6 3
Yukon Consolidated ($1)	4 6	4 4½
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	1 8 6	1 7 3
Esperanza (2s. 6d.), Cyprus	1 8	1 9
Indian (2s.)	4 6	4 6
MTD (Mangula) (5s.)	9 0	11 3
Messina (5s.), Transvaal	5 1 3	5 4 0
Mount Lyell, Tasmania	1 2 9	1 5 0
Nchanga Consolidated, N. Rhodesia	11 0 0	11 4 9
Rhokana Corporation, N. Rhodesia	28 0 0	29 0 0
Roan Antelope (5s.), N. Rhodesia	8 3	8 6
Tanganyika Concessions (10s.)	2 13 6	2 11 3
LEAD-ZINC:		
Broken Hill South (5s.), N.S.W.	2 6 0	2 6 0
Burma Mines (3s. 6d.)	1 6	2 3
Consol. Zinc Corp. Ord.	3 2 0	3 3 6
Lake George (5s.), N.S.W.	3 6	3 0
Mount Isa, Queensland (5s. Aust.)	1 6 0	1 12 0
New Broken Hill (5s.), N.S.W.	1 17 0	1 14 6
North Broken Hill (5s.), N.S.W.	3 14 6	3 15 0
Rhodesia Broken Hill (5s.)	8 6	8 9
San Francisco (10s.), Mexico	19 0	15 9
TIN:		
Amalgamated Tin (5s.), Nigeria	6 9	7 0
Ampat (4s.), Malaya	6 9	7 6
Ayer Hitam (5s.), Malaya	1 10 0	1 10 6
Beralt (5s.), Portugal	1 7 0	1 5 6
Bisichi (2s. 6d.), Nigeria	3 6	3 3
Ex-Lands (2s.), Nigeria	1 9	1 9
Geevor (5s.), Cornwall	16 6	17 0
Gold Base Metals (2s. 6d.), Nigeria	9	9
Hongkong (5s.), Malaya	4 3	4 6
Jantar Nigeria (3s.)	3 6	3 3
Kaduna Syndicate (2s.), Nigeria	2 6	2 1½
Kamunting (5s.), Malaya	9 3	10 3
Malayan Tin Dredging (5s.)	12 9	14 6
Mawchi Mines (4s.), Burma	1 9	1 6
Naraguta Extended (5s.), Nigeria	9	9
Pahang (5s.), Malaya	3 9	4 0
Siamese Synd. (5s.)	6 6	7 6
South Crofty (5s.), Cornwall	4 3	4 0
Southern Kinta (5s.), Malaya	18 3	19 9
Southern Malayan (5s.)	10 9	12 3
Southern Tronoh (5s.), Malaya	10 3	11 3
Sungei Besi (4s.), Malaya	14 0	15 3
Sungei Kinta, Malaya	13 0	13 6
Tekka (12s. 6d.), Malaya	4 3	4 3
Tronoh (5s.), Malaya	11 6	12 6
United Tin Areas (2s. 6d.), Nigeria	5½	4½
DIAMONDS:		
Anglo American Investment	10 13 0	10 11 6
Consol African Selection Trust (5s.)	16 0	16 6
Consolidated of S.W.A. Pref. (10s.)	10 6	10 6
De Beers Deferred (5s.)	6 2 6	6 8 6
FINANCE, Etc.		
African & European (10s.)	3 17 6	3 18 3
Anglo American Corporation (10s.)	8 7 6	8 19 9
Anglo-French Exploration	1 6 9	1 8 9
Anglo Transvaal 'A' (5s.)	2 0 0	2 1 6
British South Africa (15s.)	3 12 6	4 1 0
British Tin Investment (10s.)	1 0 0	19 6
Broken Hill Proprietary	2 1 0	2 2 0
Camp Bird (10s.)	—	10 0
Central Mining	3 16 0	3 19 9
Central Provinces Manganese (10s.)	1 10 0	1 11 0
Consolidated Gold Fields	3 6 9	3 8 9
Consolidated Mines Selection (10s.)	1 19 3	2 5 0
East Rand Consolidated (5s.)	1 6	1 9
Free State Development (5s.)	8 3	9 9
General Exploration O.F.S. (2s. 6d.)	5 0	5 9
General Mining and Finance	5 13 9	6 9 3
H.E. Proprietary (5s.)	14 3	16 3
Johannesburg Consolidated	2 15 0	2 17 9
London & Rhod. M. & L. (5s.)	8 0	8 6
London Tin Corporation (4s.)	8 0	8 3
Lydenburg Est. (5s.)	16 0	18 0
Marsman Investments (10s.)	1 3	1 6
National Mining	1 6	1 9
Rand Mines (5s.)	4 7 6	4 9 9
Rand Selection (5s.)	2 4 0	2 9 0
Rhodesian Anglo American (10s.)	3 19 0	4 5 0
Rhodesian Corporation (5s.)	3 9	3 9
Rhodesian Selection Trust (5s.)	18 3	17 3
Rio Tinto (10s.)	2 15 0	2 14 3
Selection Trust (10s.)	4 17 6	5 5 0
South West Africa Co. (8s. 4d.)	13 9	13 9
Union Corporation (2s. 6d.)	2 9 0	2 13 9
Vereeniging	6 10 0	6 10 0
West Rand Inv. Trust (10s.)	2 16 3	2 18 0

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Lode Tin in Alaska

Introduction

"Lode-Tin Mining at Lost River, Seward Peninsula, Alaska" is described by S. H. Lorain and others in Information Circular 7871 of the United States Bureau of Mines, from which the following notes are abstracted. The authors say that the western part of the Seward Peninsula has been the principal source of primary tin produced on the North American Continent; the area also contains the largest known reserves of lode and placer tin on the continent. In late 1942 and early 1943, after two-thirds of the tin resources and nearly three-quarters of the tin-smelter capacity of the world had been denied to Allied Nations by the Japanese conquest of south-east Asia, the Operating Committee of the United States War Production Board approved Government construction of a 500-ton mill at the Lost River mine to recover tin from the most promising lode deposit so far discovered on Seward Peninsula. Construction was contingent on non-interference with military shipping in that area. Because of the critical shipping situation brought on by the Japanese invasion of the Aleutian Islands the Army decided that the production potential of the Lost River mine did not have enough comparative importance to the war effort to justify diversion of badly needed cargo space; consequently the construction project was not begun.

Under authority conferred by the Stockpiling Act of June 7, 1939, the United States Bureau of Mines, in co-operation with the U.S. Geological Survey, began diamond drilling and trenching investigations of the Lost River mine area in August, 1942. Beneficiation studies of ore from the Cassiterite dyke were conducted at Bureau laboratories and a flow-sheet for treating the ore was developed. Under the stimulus of the Korean War and the authorities created by the Defence Production Act of 1950 the Government advanced funds to the United States Tin Corporation for constructing plant facilities for mine equipment and development and for mine and mill operation from May 15, 1951, to October, 1955.

General Geology

The tin deposits of the Seward Peninsula have been the subject of numerous investigations by the Federal Geological Survey since their discovery in 1900. The tin-bearing areas are underlain by slates and limestones that have been intruded by granite and associated dykes. Granite stocks are exposed at Cape and Brooks Mountains, Tin Creek, and Black and Ear Mountains. Similar stocks were inferred from surface indications at Potato Mountain and Cassiterite Creek; existence at the latter was confirmed by diamond drilling and underground workings at the Lost River mine. Tin mineralization has been found associated with all known and inferred granitic intrusives except that at Black Mountain. Because all the granites have similar chemical composition and almost identical association with quartz-bearing rhyolite and dacite dykes, they are believed to have a common deep-seated origin.

At Lost River numerous metallic minerals occur in widely varying amounts in the acid and basic dykes, in the contact-metamorphic zone of altered limestone around and overlying the granite stock, and, to some extent, along zones of fracture in comparatively unaltered granite or limestone. Cassiterite and wolframite are the chief ore minerals; other metallic minerals present in lesser amounts include scheelite, galena, marmatite, chalcopyrite, stannite, arsenopyrite, pyrite, molybdenite, stibnite, and bismuthinite. Traces of cadmium, indium, and other rare elements also have been identified. Non-metallic gangue minerals include quartz, fluorite (often in concentrations), topaz, tourmaline, zinnwaldite, clay minerals, and lime-magnesium silicates.

For mining purposes the deposits at Lost River may be classified as vein-type or "dyke" deposits and "disseminated" deposits; the latter includes the contact-metamorphic zone and the zones of fracture in granite or limestone.

Disseminated Deposits.—Cassiterite and other metallic minerals occur in numerous discontinuous lenses and veinlets and as disseminations throughout a wide irregular zone of altered granite and metamorphosed limestone adjacent to and overlying the buried granite stock. Although many high assays for tin and tungsten may be obtained from samples taken within this zone the general average is comparatively low and distribution of the metal content appears to be erratic. Along the contact, particularly where strong mineralization has developed, both the granite and the limestone are intensely fractured and altered. In many places the granite is almost completely kaolinized and the clay constituents swell rapidly when exposed to air and water. In these areas openings that are not heavily and tightly timbered will close completely in a few months.

Except for comparatively minor exploration no

development of the disseminated deposits has been attempted. On the basis of limited information now available the recovery of tin from these deposits could only be accomplished by using large-scale mining methods that require no ground support, such as block caving or open-cutting.

Dyke Deposits.—All ores mined to date and all reserves indicated by mine workings are in the Cassiterite dyke or at the intersection of the Cassiterite dyke with the Ida Belle dyke. The surface of the Cassiterite dyke has been traced throughout a strike length of about 8,000 ft.; it has been proved by exploratory workings to be tin bearing throughout a strike length of about 2,200 ft. and throughout a vertical range of about 1,000 ft. The width of the dyke ranges from about 5 ft. to about 20 ft.; the dip ranges from 60° to 80° and the strike from S. 60° E. to N. 85° E. Generally the width and dip are nearly uniform at about 12 ft. and 70°, respectively, but locally the dyke may roll and pinch or swell. Usually the tin content is lower where the dyke narrows.

Where it is unaltered the dyke appears to be a normal rhyolite porphyry dyke, but within the ore-bearing sections it has been shattered by irregular fractures and differentially altered by hydrothermal solutions. The degree of shattering as well as the nature and intensity of alteration differs from place to place in the dyke; generally the numerous fractures and irregular seams and masses of claylike material create an unstable condition in any mine workings that may be driven within the dyke.

The limestone walls of the dyke are only slightly fractured and altered; consequently, they generally are firm except in places where a breccia zone, which may be as much as 6 ft. in width and usually is tin-bearing, is on the hanging-wall of the dyke. It is apparent that mining operations on the Cassiterite dyke involved only the relatively simple problem of mining a soft vein between firm walls; the principal difficulties are caused by hanging-wall breccia and by the fact that the dyke material usually is so unstable as to require close timbering of its permanent openings. Fortunately, most openings in the limestone will stand indefinitely without support.

The Ida Belle dyke is 15 ft. to 55 ft. in width; this dyke or dyke system has been traced by intermittent surface indications throughout a strike length of about 3 miles, but it is known to be tin bearing only within the first 750 ft. easterly from its intersection with the Cassiterite dyke. The composition and general character of the Ida Belle dyke and its walls are similar to comparably mineralized parts of the Cassiterite dyke; therefore it may be assumed that if ore-shoots of minable grade are discovered in it the mining conditions will be similar to those in ore-shoots in the Cassiterite dyke Mining costs in the Ida Belle, however, should be appreciably lower because of its greater width.

Numerous other dykes in the immediate vicinity of the Lost River mine are known to be tin bearing, but have not been explored. If ore-shoots are discovered in them presumably they would present essentially the same mining problems as the Cassiterite dyke.

Almost all tin ores obtained from the Cassiterite dyke were mined by an advancing system of shrinkage stoping; insignificant production was obtained from stope development and preparation headings. All stopes were above the No. 3 adit level. Nearly all development and much preparation of the stope were done in the limestone foot-wall of the dyke; only one stope (the A-I-E) was developed in or on the hanging-wall of the dyke. Several methods of stope development, preparation, drilling, and ore drawing were tried; various sizes of stope blocks also were tried. Direct comparison of the longhole and conventional methods of shrinkage stoping as practised at Lost River is not possible because both methods often were employed in the same stopes and performance records were not maintained separately.

Milling

The United States Tin Corporation mill at Lost River, Alaska, was opened in June, 1952, and operated semicontinuously until September, 1955. According to company records over 51,000 short tons of ore (with an average 1·13% Sn) was treated by gravity-concentration methods to produce 687·1 tons of concentrate (with an average 52·0% Sn); the average recovery of tin was 62·0%. The gravity concentrate was treated by flotation to remove sulphides; the beneficiated concentrate was barrelled and shipped to the tin smelter at Texas City, Texas.

Mill recovery was well below that indicated by laboratory mineral-dressing tests, due chiefly to mechanical limitations of the grinding circuit that prevented disintegration of ore without excessive sliming of cassiterite.

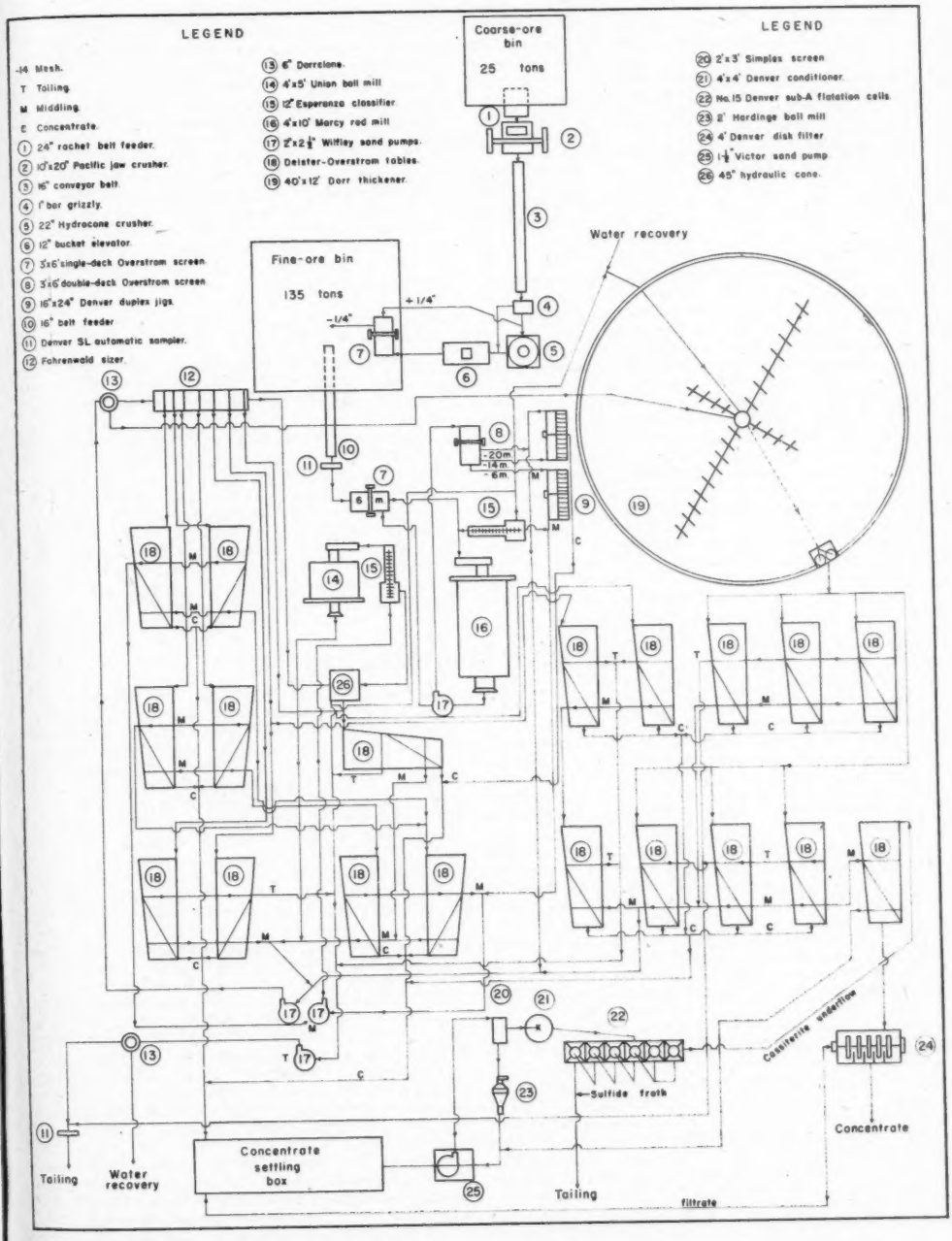
The Lost River ore essentially contains kaolinite, altered feldspar, quartz, white topaz, cassiterite, a magnesia-bearing calcite, fluorite, sericite, and zinnwaldite; some muscovite, limonite, pyroxene, amphibole, and chlorite; varying amounts of galena and sphalerite; small amounts of arsenopyrite, wolframite, scheelite, cerussite, and apatite; trace amounts of altered pyrite, chalcopyrite, smithsonite, malachite, bismuthinite, and stibiconite. Petrographic study indicates that most cassiterite is liberated in the *minus*-48-, *plus*-100-mesh size range, although some cassiterite is liberated as coarse as 10-mesh and a small amount remains locked in the *minus*-200-mesh fraction.

Laboratory testing and mill operations show that grinding the ore with light ball load and low pulp density liberates the cassiterite in the coarser sand fractions and increases recovery. Mechanical limitations of the mill grinding circuit, however, did not allow this practice; consequently a large quantity of the tin mineral was ground finer than 200 mesh. Much of the fine cassiterite thus formed was held mechanically by the kaolinite slime and thus rejected into the mill tailing.

In addition to variations in hardness of the ore considerable variation in grade of ore was noted from day to day. This, of course, necessitated constant adjustment of table operations (transverse tilt, wash water, position of product splitters), unnecessary with constant feed grade.

The Lost River mill was not planned and constructed as a unit; instead it was built piecemeal to remedy initial deficiencies and to meet the needs of increased production. The result was a plant not only inconvenient to operate but extremely difficult to service.

When operations were suspended most of the machinery in the mill was in operating condition or could be made usable by minor repairs. Operating the mill according to the present flow-sheet,



Flow-Sheet, Lost River Mill, 1954

however, would necessitate replacement of two major items of equipment—the rod and ball mills—responsible for a large part of the mill repair costs and interrupted operation. Mere replacement of these items would not solve any metallurgical or operational problems nor effect an increase in the recovery of tin. Operating the existing mill without remodelling should be considered only if circumstances allow no other course of action.

Remodelling should include a rod-mill and oversize return equipment large enough to allow grinding with low pulp density and a high circulating load. A smaller rod- or ball-mill should be installed for regrinding the table middling. Practice at Lost River included wet screening the ore fed to the grinding circuit in an attempt to remove fine sand and clay slime. Much of the ore consists of rock and mineral particles cemented by clay; these "clay balls" are not disintegrated easily by wet screening alone and they pass over the screen to the rod-mill. More complete disintegration doubtless could be effected by using a log washer or similar device. Removing the additional fines before grinding would minimize over-grinding the cassiterite. It is suggested that the log-washer discharge material be routed to a cyclone or bowl classifier to remove the bulk of the clay from the circuit immediately and assure no overload on the spigot-type hydroclassifier. Ideally, the disintegration-fines removal unit should be placed ahead of the secondary crusher, so that it would eliminate the packing and plugging troubles that have been experienced with that unit.

Supplementary remodelling to increase operating efficiency should include enlargement of the coarse-ore bin to allow storage of mill feed for 12 hours and installation of a vibrating grizzly feeder to transport ore from the coarse-ore bin to the primary crusher. These changes would reduce operating troubles and labour costs by requiring the primary crusher to operate only one shift for a full day's supply of ore to the mill

The recommendations given in the Circular are based only upon laboratory bench-scale tests and limited observations of practice in the existing mill. If future operation is a possibility research on the following scale should be conducted to obtain enough detailed data for intelligent planning :—

(1) The Aerofall mill could be used for disintegrating Lost River ore.

(2) Additional bench-scale beneficiation testing on Cassiterite-dyke ore, supplemented by continuous testing on a laboratory scale.

(3) Investigations of the nature and amenability to concentration of ore minerals from the contact zones and from dissemination in both granite and limestone.

(4) Studies to determine the applicability of various dispersants to facilitate separation of fine cassiterite and clay minerals.

(5) Investigation of various flocculents to increase the efficiency of water reclamation.

(6) Investigation of methods for economic recovery of by-product minerals—such as, those of tungsten, lead, and zinc.

(7) Continued basic research to develop a method for recovering cassiterite by flotation.

Jaspilite Beneficiation

A note by S. G. Salamy on a "Pilot Plant for Jaspilite Ore Beneficiation" appears in the *Chemical Engineering and Mining Review* of Melbourne for December 15. This type of rock, the author says, consisting of silica and iron oxide in varying proportions, is one of the host rocks of the high-grade ore deposits situated in the Middle-back Range of South Australia. A deposit of jaspilite occurs north and adjacent to the Iron Monarch high-grade ore deposit. In November, 1950, the drilling of this deposit of jaspilite was commenced by the Broken Hill Proprietary Co., Ltd. and to-day is the only proved deposit of low-grade iron ore in South Australia. The drilling programme indicated the grade and tonnage of the deposit and showed that the material was a mixture of haematite and silica. The haematite in the jaspilite was found to be martite, indicating that the jaspilite was formerly a mixture of magnetite and silica, the magnetite being oxidized to haematite. In 1956 an investigation was conducted by company staff to determine the amenability of jaspilite to beneficiation. This investigation was carried out in the joint laboratories of the Commonwealth Scientific and Industrial Research Organization and Melbourne University Mining Department. As a result a flow-sheet was postulated for the benefication of jaspilite to produce an acceptable product for feeding to blast-furnaces.

A pilot plant has been established at Whyalla, South Australia and is composed of two sections—*viz.*, reduction furnace and concentrator. In the reduction furnace the jaspilite is converted to a mixture of magnetite and silica. This is achieved in a shaft-type furnace, 3 ft. internal diameter and 27 ft. high. Superimposed on the furnace are feed hoppers of additional height of 11 ft. giving an overall height of the pilot plant of 38 ft.

The reduction of haematite to magnetite is achieved by passing a reducing gas, carbon monoxide *plus* hydrogen, through the heated jaspilite. In order to achieve fuel economy heat exchangers are incorporated in the furnace so that both reduced jaspilite and gases leave the furnace at some 110° C. The reduction furnace is fully instrumented and controlled and has a nominal capacity of 2 tons of product per hour. It is designed for continuous operation.

Samples of reduced jaspilite are sent to the concentrator where they are ground in a ball-mill, in closed circuit with a cyclone classifier, to 90% *minus* 325 mesh Tyler. The magnetite is then separated from the silica by wet magnetic separators which yield a magnetite concentrate and a silica tailing. The magnetite is filtered to a satisfactory moisture content for agglomeration and the silica is stored in a tailings dam. The concentrator has a nominal capacity of 1 ton of feed per hour and is operated on an 8-hour day basis.

In addition to proving that the process is applicable to the known deposit, both in depth and in area, it should be possible to predict the results to be obtained by treating jaspilite when it is mined. Upon completion of the test programme the company will have sufficient data to design the most economical commercial installation for the beneficiation of the deposit of jaspilite occurring north and adjacent to the Iron Monarch high-grade ore deposit.

Diamonds in Brazil

An article by R. E. Mieritz in the *Mining World* of San Francisco for January reviews possibilities of diamond production in Brazil. The author says that diamonds are known to exist in the present river beds and hills of at least 12 states in Brazil. Four states, however, are considered the principal producers. These include Minas Gerais, Matto Grosso, Goias, and Bahia. Here in these hilly, mountainous, sparsely-vegetated, uplifted plateaux thousands of *Garimperios* (he who searches diamonds) win diamonds by primitive methods for a meagre existence in the known fields. Over 90% of the diamonds mined in Brazil are of gem quality, primarily because little attempt has been made to recover the smaller sizes and to search for diamonds which could be used for industrial purposes. If it were not for the fact that several million carats of diamonds have been illegally exported Brazil could possibly have been credited with some 20,000,000 carats or more over the many years that diamonds have been mined. At present all diamond discoveries and production should be registered with Federal authorities so that statistics can be gathered and State and Federal taxes can be collected on subsequent transactions involving the stones. Even now, however, many stones elude the Federal clutches. Overall taxes amount to about 30% of the gross value of the stones with adequate allowance for depletion and depreciation.

To date, the author says, no satisfactory geological theory as to the origin of Brazilian diamonds has been written for general publication and discussion. The question is a subject requiring detailed information. Other than present river placers and buried ancient placers, diamonds have been reported from kimberlite, quartz veins, and blue clays. Rocks of regional importance are the pre-Cambrian lavas, sandstone, and quartzite, pre-Cambrian schist, early Palaeozoic formations, igneous intrusions such as diorite sills, and dykes or pegmatite intrusions.

Active mining is generally limited to the present river channels and the buried ancient river or lake deposits which are considered the most profitable of all occurrences. These secondary deposits the author classifies as: (1) True placers; (2) soft conglomeritic "massa" placers, and (3) hard conglomeritic "massa" placers. The last two are ancient river channels or lake beds and are differentiated only because of their physical characteristics—namely, hardness and cementation of the material. All conglomeritic material is not necessarily "massa." This word is used only to identify the diamond-bearing formations. Massa not only contains diamonds, but also such heavy minerals as staurolite, rutile, tourmaline, magnetite, and zircon. The occurrence of these minerals varies in deposits and districts.

The soft massa deposit is usually situated at the higher elevations. Here deep lateritic weathering has altered the clays to greasy saponites and the sandstone or quartzite boulders to a soft sand of individual sub-angular grains that still retains the boulder and gravel outline which is discernible primarily by colour. This type of deposit is readily disintegrated under water pressure. The hard massa deposit is a relatively fresh conglomerate of moderate to strong cementation and extremely difficult to disintegrate under 250 pound-per-square-inch water pressure.

Proper and complete exploration of any deposit is a definite prerequisite to any successful mining operation; however, little or no thought has been pursued in connexion with adequate exploration and evaluation of the diamond deposits in advance of an operation. Failure to do so is perhaps a result of the generally known and accepted fact that diamonds occur always associated with the heavier minerals previously mentioned, whether in the present river channels or the ancient conglomeritic river channels or lake beds. Some exploration has been completed by small churn drill holes but this has been successful only to the extent of indicating and delineating the limits and thicknesses of the massa. This type of exploration has not been successful as a means of determining grade of the deposit. Most deposits now in production are being operated on a hit or miss schedule of insecurity, since it is not actually known whether the material contains diamonds. Recovery is the only answer in most active operations.

A factor which has perhaps discouraged sampling of a diamond deposit is the extremely high ratio of worthless particles to valuable particles. In the case of a $10·00 per-cubic-metre value this ratio is approximately 54,000,000 to one on weight. In normal exploratory sampling the geologist or engineer usually thinks in terms of pounds or, at the most, tens of pounds. In sampling a diamond deposit they will be required to think in terms of tons—usually 2 to 4 tons per sample length which should not exceed 5 ft. but preferably 3 ft. Such exploration becomes a major and expensive problem since the sample requirements indicate a large area excavation or penetration must be made to depths of 60 ft. to 120 ft. in most deposits. A comparable size opening would be a minimum 3 ft. by 3 ft. shaft.

Previous exploration and production of one deposit indicates the diamonds concentrate within the bottom 3 metres or 10 ft. of the formation immediately above bedrock. Consequently only this portion or at the most the bottom 15 ft. of the massa need be sampled.

To date sampling of a diamond deposit has not been given much serious thought; however, one operating company may well have the economic solution to the problem. Any excavation or penetration in these soft massa deposits requires some sort of support or guard against caving. The United Diamond Fields of Brazil has inaugurated the use of large-diameter (40-in.) hole drilling with a machine not heretofore considered an exploration tool. The Calweld (bucket type) earth drill, normally used for drilling cesspools or caisson holes in construction, is being adapted as an exploration tool in this particular field, 40-in. casing in 4-ft. sections with a rotating drilling shoe being used in conjunction with the drilling bucket. The hole is cased simultaneously as it is advanced. Each 3-ft. sample would contain approximately 2·2 short tons of material from an 8·7 sq.ft. hole area.

Only the bottom 15 ft. of the Campo Sampaio deposit (the operating property of the company) is being sampled. The barren material above the sampled area is rejected. Samples are run through a pilot mill where each is automatically weighed, milled, and diamonds collected. All pertinent data is recorded and valuations are placed on a specific

area. It is too early at this writing to describe completely the success of the method except to say that results are definitely a great aid to the planning of future mining operations.

The rig is limited in its drilling ability, since its application can only be considered for soft consolidated or unconsolidated material such as the soft massa deposits and present placer deposits, where it can be dredge-mounted rather than truck-mounted for portability.

Asbestos in China

Writing on Chinese asbestos in the *Canadian Mining Journal* for December Sun Yi-Ming says that all varieties of asbestos are found in that country. The bluish-grey fibre of the amphibole variety, crocidolite, produced in Nanyang County, Honan Province, Central China, has silky fineness and lustre. The fibre is 2 cm. to 5 cm. long but its tensile strength can hardly bear the disintegration action under mills and carding machines. However, the fibre has admirably good resistance to acid.

Amosite is produced in Pingli County, Shensi Province. In colour, fibre length, and tensile strength it is very much like that produced in Africa.

The most industrially valuable chrysotile is found in Laiyuan County, Hopei Province, and Penghsien and Shihmien counties, Szechwan Province. The fibre from Laiyuan County is of brownish colour when it comes from the mine but is pure white when crushed and opened. Its length is generally 2 cm. and sometimes reaches 4 cm. or 5 cm. With high tensile strength it is suitable for any product of high quality. The mode of occurrence of the asbestos veins in Shihmien County, Szechwan Province, is extremely complicated since cross-fibre, slip-fibre, and mass-fibre all exist together in the ore. The fibres are usually of a slight grey tint and are partly adulterated with brownish pieces at the ends. The fibres are long and not as easily carded as the ordinary varieties from other localities of China. Being very high in tensile strength the fibres are very valuable in spinning and weaving the best quality products.

The fibre produced in Chinhsien County, Liaoning Province, is characteristically harsh but it has high tensile strength. It is especially favourable for manufacturing asbestos-cement products.

Admirably long but harsh and brittle, the fibres produced in Chian County, Kirin Province, and Taan County, Shensi Province, are easily broken in milling and opening operations. They cannot be used for purposes where high tensile strength is essential.

Chemical analysis of asbestos of different localities in China shows that the content of water of crystallization varies with the different mines although the asbestos is of the same chrysotile. The fibres produced in Shihmien, Penghsien, and Laiyuan counties have very high tensile strength, while those in other localities do not. The asbestos mined from the limestone strata in Laiyuan is free of iron and so is especially valuable for making products for electrical insulation.

Laiyuan County, Hopei Province, and Shihmien and Penghsien counties, Szechwan Province, are the three major asbestos-producing localities of China. Asbestos was first struck in Laiyuan in 1914 and in Shihmien and Penghsien in 1918. The mines were worked intermittently and unsystematically until 1949. The deposits in Taan, Pingli, Yuankiang, and the blue asbestos in Nanyang were discovered and worked since that time. No exact date of mining for the other deposits is available but it was within the past 25 years. Since 1949 the planned and systematic development of this industry has provided not only sufficient products for home needs but also a surplus for export including both the raw material and some of its products.

In 1932, the year before China's First Five-Year Plan, only 2,000 metric tons of asbestos fibre were produced in Shihmien County. The estimated output for 1957 is 20,000 metric tons, the target set in the First Five-Year Plan. Laiyuan County, Hopei Province, had an output of 1,282 metric tons in 1952. In 1957 it is expected to reach the target of 3,300 metric tons. Penghsien County, Szechwan Province, which has high-quality asbestos produced 387 metric tons in 1952 but reached 853 metric tons in 1956.

The annual production of China is still very low, but from the point of view of growth it is quite remarkable.

Because of the growing needs for asbestos products both at home and abroad the asbestos mining industry now cannot satisfy the needs of the manufacturing industry. The situation will be improved in the very near future when measures for stepping up mining and milling are carried out.

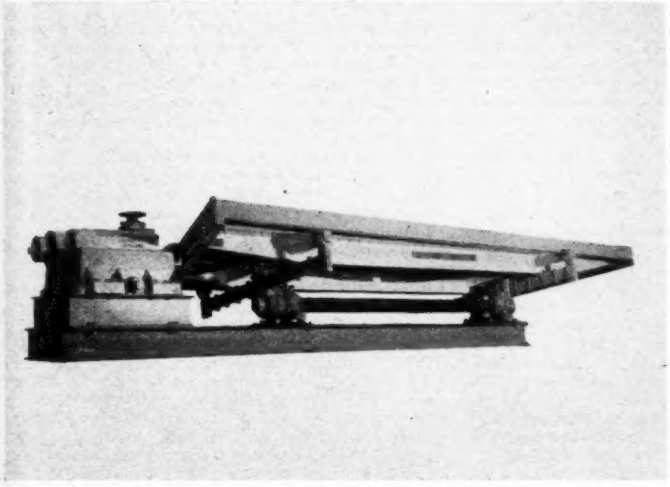
Trade Paragraphs

W. J. Jenkins and Co., Ltd., of Retford, Notts., have produced a catalogue of idlers. These include 14-in. to 16-in. three-pulley types and 24-in. to 60-in. five-pulley, disc-type return idlers, and idlers for light duties.

Neldco Processes, Ltd., of Crossways House, Bracknell, Berks., announce that this is now the address of their offices, to which they have recently moved from Ashford. The telephone number is Bracknell 1789.

Richard C. Gibbins and Co., Ltd., of Berkley Street, Birmingham, recently issued some information on their standard range of hand and powered winches covering loadings from ¼ ton to 7 tons. Two versions are available—one with squirrel-cage motors and one with slip-ring.

Wild-Barfield Electric Furnaces, Ltd., of Otterspool Way, Watford By-Pass, Watford, Herts., referring to a previous order from the United States for mains frequency induction heating aluminium holding furnaces, state that a further order for similar 750-lb. capacity equipment has been placed.



Wilfley Table.

Allis Chalmers Great Britain, Ltd., of Essendine, near Stamford, Lincs., announce that Mr. D. A. Wooley has been appointed manager of their London office. He replaces Mr. D. C. Altman, who, as was stated in the January issue, has been appointed assistant managing director of the company.

J. E. Lesser and Sons, Ltd., of Green Lane, Hounslow, Middx., in an illustrated leaflet call attention to their semi-permanent single-storey buildings suitable for a variety of purposes which can be erected by unskilled labour with adequate supervision. Construction and mine camps suggest themselves as possible applications.

W. H. Dorman and Co., Ltd., of Stafford, announce that they have acquired the whole of the undertaking of **W. B. Bagnall, Ltd.,** of Stafford. The first-named company are well known as manufacturers of diesel engines and Bagnalls have for many years enjoyed a reputation as makers of locomotives, including, more recently, diesel-mechanical and diesel-electric types.

Graton and Knight, Ltd., of Warwick Road, Boreham Wood, Herts., have published a new edition of their Graknight V drive manual. This gives in text, tables, and illustrations the essential information required by users of this form of transmission. The special qualities of the company's Raycord belt are also set forth, together with notes on fitting and storage.

R. F. Fraser-Smith, of 69 Kings Cross Road, London, W.C. 1, announce that they are able to supply radiographic equipment and accessories and that in particular they are manufacturers of Gamma ray equipment of a new design. They welcome inquiries on the subject of non-destructive testing. The telephone number is TERminus 1064–5.

Russell Constructions, Ltd., of Russell House, Adam Street, London, W.C. 2, issue some details of their Invicta screen for high-speed sieving and straining. The screen surface is 3 ft. diameter and is suitable for dry or wet separation at rates of up to 10 tons or 12,000 gal. per hour. It is a development from the machine described and illustrated in the MAGAZINE in August, 1955.

Belmos Co., Ltd., of Bellshill, Lancashire, give particulars of the type SDU drill control unit which is a new addition to their range of flameproof motor control gear designed to N.C.B. specification and suitable for controlling one 3-h.p. drill or two 1½-h.p. drills from a.c. supply systems up to 650 volts. It is certified flameproof by the Ministry of Power under Certificate No. 4087 for Group 1 gases.

Newman Industries, Ltd., of Yate, Bristol, have just introduced a new range of totally-enclosed motors, ¾ to 2 h.p., in "66" frame dimensions designed to bridge the gap which usually exists between fractional horsepower motors and the smallest of the industrial type motors. Its introduction means that the company can now offer a complete range of motors from ½ to 600 h.p. to N.E.M.A. standards.

United Coke and Chemicals Co., Ltd., of Orgreave, Handsworth, Sheffield 13, a subsidiary of the United Steel Cos., Ltd., which is already supplying rolling-mill bearings of "Orkot," state that this is a fabric-reinforced resin which has been proved suitable for the purpose. More recently it has been used in the manufacture of bushes. In many cases, it is claimed, this has resulted in important power savings as well as increased life in bearings.

Darlaston Galvanised Holloware Co., Ltd., of Progress Works, Holyhead Road, Wednesbury, Staffs., has recently installed plant capable of bonding many polythene and other types of plastic to ferrous or non-ferrous metal by the "Plasinter" process which, it is claimed is particularly suitable for wire work, tubular steel assemblies, sheet metals, aluminium ware, brackets, castings, etc. P.V.C., P.T.F.E., P.T.F.C.E., and Nylon, in addition to polythene coatings will give added strength and resistance to chemical action.

Wilfley Mining Machinery Co., Ltd., of Allen Road, Rushden, Northants., make available a photograph, which is reproduced on page 123, of their No. 25 concentrating table. This table with the new Curnow lateral spring suspension was described in a note in the January issue. The illustration shows the simplicity of the mounting consisting of leaf springs supporting the table deck and the heavy pedestal bearings on which the whole assembly pivots; also the substantial timber bracings which ensure rigidity and prevent warping of the deck.

Thomas Smith and Sons (Rodley), Ltd., of Leeds, the crane and excavator manufacturers who have been established at Rodley since 1820, announce the following recent appointments. Mr. Arnold Carr, deputy chairman of Thos. W. Ward, Ltd., has been appointed chairman of the company and Mr. W. H. Sharp, who for many years has been joint managing director, has been appointed sole managing director. These appointments are consequent upon the death of Mr. Frank R. Stagg, who had been chairman and joint managing director since 1948 and who was also deputy chairman of Thos. W. Ward, Ltd.

Sumo Pumps Ltd., a member firm of Stone-Platt Industries, Ltd., of Oceanic House, Cockspur Street, London, S.W. 1, announce that their range of submersible pumps are now fitted with their new Clam-Seal motors. These motors, originally developed for use in parts of Texas to resist sand in bore-hole water, are pre-filled with oil and completely sealed against sandy water. Not only is the possibility of damage by sand therefore overcome but also the troubles caused by hard and aggressive waters. Another announcement states that **Hayward, Tyler and Co., Ltd.,** of Luton, have established a joint office with Sumo Pumps, Ltd., to serve their respective interests in the Midlands

D. R. Illuminations, Ltd., of Warren Street, Stockport, Cheshire, call attention to a recent development in the lighting of non-gaseous mines—namely, the use of an integrally-moulded neoprene lampholder and cable in continuous lengths with the lampholder situated at convenient intervals. The arrangement is both weather and dust proof. Various Swedish mining and quarrying concerns, it is stated, now use this method and it is understood that one of the Northern Rhodesian copper-mining companies is contemplating an installation. For use with such a festoon lighting arrangement the makers have also developed a fibreglass reflector which is described as practically unbreakable and impervious to vapours.

Teddington Industrial Equipment, Ltd., of Sunbury-on-Thames, Middx., have developed, with the assistance of the N.C.B. and various compressor manufacturers, a system of comprehensive protection equipment which provides completely automatic supervision for all types of compressor, it is stated. This system, which can be applied equally well to reciprocating or rotary plant and can be used for installations both above and below ground is already installed in a number of collieries in the Midlands and Durham Divisions. It provides advance warning of abnormal running conditions, followed by automatic shut-down before dangerous operation can occur. Not only does it prevent hazardous operating conditions but it also protects the compressor against damage caused by accident or lack of maintenance.

B.T.R. Industries, Ltd., of Herga House, Vincent Square, London, S.W. 1, announce an agreement whereby the company acquires the whole of the capital of Microcell, Ltd., and of the associated companies Glass Yarns, and Deeside Fabrics, Ltd., and Artrite Resins, Ltd. Mr. Henry Kremer, chairman and managing director of Microcell, Ltd., will continue in that capacity and will join the board of B.T.R. Industries, Ltd. Microcell, Ltd., whose main factories are at Camberley and Blackwater, Surrey, in addition to being engaged on important Government work, operate three main manufacturing divisions—namely, aircraft engineering, plastics, and electronics. An announcement by Microcell, Ltd., states further that Dr. W. D. Scott, assistant managing director of B.T.R. Industries, Ltd., and Major C. J. P. Ball, are to join their board

Libu Shovel Co. AB, of Stockholm (British representatives: Libu Shovel Co. (Great Britain) Ltd., of Amersham, Bucks.), in an illustrated leaflet give particulars of their side-tipping bucket. This is in fact a three-way dump bucket hydraulically operated and designed for use with Caterpillar Traxcavators Nos. 977, 955, and 933. The buckets have plough-formed cutting edges made of Bofors steel and the leaflet contains interesting capacity figures resulting from their use. Mention is made in this also of the fact that six shovels have been supplied to St. Patricks Copper Mines at Avoca, Eire. The volume of the buckets is the same as of the corresponding conventional types. The height for the buckets in dumped position is for type 2100, 65 in.; 2350 H. D., 80½ in., and 2650 H. D., 92½ in. They are tippable at every height on a conveyor system, on trucks, and on big dumpers.

Cambridge Instrument Co., Ltd., of 13 Grosvenor Place, London, S.W. 1, announce that work has started on a new building for their research laboratories at Cambridge. At the same time they draw attention to their Numalec pneumatic-electric controller. This instrument will control temperature, pressure, vacuum, level, etc., each for set (adjustable) periods and in the sequence required. In controlling, for example, a complete process, it will maintain one or more temperatures at the desired values for precise periods, govern levels, pressures and draining, give warning of any supply failure, and indicate the completion of the process. In its simplest form the controller will raise the temperature of, say, an electric oven to a set value, maintain the temperature for the required period, switch off, and indicate completion of the cycle. In all cases operation is simple, the sequence being initiated by pressing one button. The controller is, however, so versatile that the whole programme can be changed within three minutes.

Holman Brothers, Ltd., of Camborne, Cornwall, announce the appointment of Mr. J. M. Williams as an associate director. Mr. Williams has taken up the position of London director at 44 Brook Street, W. 1. He is already a director of two of the company's subsidiaries, Climax Rock Drill and Engineering, Ltd., and Maxam Power, Ltd. His new position reflects the recent expansion of Holman interests, the heavy demands made on the time of the Camborne-based directors, and the need for a director permanently in residence in London. During 1958 the company having acquired control of Climax Rock Drill and Engineering, integrated the operations of the two companies. Mr. Williams was in control of the whole of this re-organization which affected production and administration arrangements in the Camborne area. Additionally there has been a marked growth in the activities of three subsidiary companies—Maxam Power, Ltd.,

Goodyear Pumps, Ltd., and the Dustuctor Co., Ltd., all of which have London offices at Brook Street.

Johnson, Matthey and Co., Ltd., of Hatton Garden, London, E.C. 1, announce that they are now producing Platinax II, a cobalt-platinum magnetic alloy. The outstanding magnetic properties of certain alloys in the cobalt-platinum system have been known to metallurgists for many years, but it is only in recent times that the properties of the alloy containing an equal number of atoms of each element (23·3% by weight of cobalt) have been fully appreciated. Platinax II is the latest development in this field and is one of the most powerful permanent magnet materials. After heat treatment by a special JMC process Platinax II has remarkable physical and magnetic properties, a remanence of about 6,400 gauss, a coercive force of 4,800 oersteds, and a BH(max) of 9·2 by 10^6 gauss-oersteds being obtainable. Moreover in the heat-treated state the alloy is magnetically isotropic, exhibiting similar magnetic properties in all planes. Apart from the benefit of its exceptional magnetic properties the use of Platinax II offers a further advantage in that the alloy is comparatively workable before heat treatment and can be machined, rolled, and drawn without difficulty and so lends itself to the manufacture of magnets of complicated shape or extremely small size.

Quasi-Arc, Ltd., of Bilston, Staffs., state that they have developed new techniques to speed up double-ending welding of pipelines and make this a more practical proposition on site. The development follows the need for increased speed of pipeline welding resulting from expanding development programmes of the oil and chemical industries. In double-ending welding pipe lengths are first automatically welded in pairs before being laid. This reduces the amount of manual welding on site by almost half. A new manipulator has now been designed for improved handling of the pipe lengths. Driving rolls are used along the complete length of pipe, whereas the previous double-ending machine used only main driving rolls, with idler rolls along the rest of its length. This new machine will handle pipes up to 40 ft. long in pairs and, to accommodate different diameters, the welding head is fully adjustable on the vertical column. In operation these manipulators accept the pairs of pipes on a cradle fitted with rollers, which, in much the same way as the roller beds used for large vessels, rotate the component while the welding equipment remains stationary. The handling of pipe lengths on and off the roller bed is carried out by hydraulic means. Speed of rotation is varied according to the pipe being welded and the automatic equipment and welding technique employed. The new manipulator is carefully designed to ensure correct and even speeds and to give consistent alignment under the welding head, without allowing the work to drift longitudinally along the rolls. Any of the company's normal automatic welding processes, including Fusarc/Co_2, Fusarc, or Unionmelt, can be used with the new equipment, which is designed as a completely self-contained unit. Complete engine-driven equipment provides a.c. power operation of the rollers and d.c. supply for welding and all ancillary supplies.

Durham Raw Materials, Ltd., of 1–4 Great Tower Street, London, E.C. 3., announce that they have been appointed sole selling agents in the U.K. for the full range of filter presses manufactured by **F. H. Schule, Ltd.,** of Hamburg, Germany. Schule filter presses can be supplied to standard patterns or to special designs to cover any industrial filtration application such as in the chemical and mining industries. The presses permit the accommodation of large filter areas within a small space and pressure can be adjusted to the most favourable rate of flow to achieve the best filtrate output even with tough materials. The solids have a low moisture content and can be thoroughly flushed prior to removal from the press. These presses are of two basic types: Flush plate and frame presses, for use where the filter cake is of uniform thickness and porosity and facilitates an effective flushing of the solids, and recessed plate presses, for use where solids are subject to blockage. Both these types are available with plate sizes from 9¾ in. to 57 in. A lightweight filter press is available for applications for which a maximum pressure of 45 p.s.i. is stipulated. A lightweight plate is also supplied which permits easier handling and better filtrate discharge and causes less wear and tear on the filter cloths. A special laboratory press with a 5-in. plate, fitted with "Plexiglass" frames and plates, is also available to provide for visual control of the filtering and washing processes. The presses are supplied with either mechanical or hydraulic closing devices. The latter incorporate the Schule hydraulic spindle, which makes this form of closure possible without the use of pumps, valves, pipes, and liquid containers. This can be electrically controlled. The Schule factory incorporates a modern laboratory for the solving of filtration problems. Samples of slurry sent to Durham Raw Materials, Ltd., will be forwarded to this laboratory for determination of the most suitable filtration and equipment.

BTH Review of Progress

British Thomson-Houston Co., Ltd., of Rugby, issue their usual annual report, from which extracts follow. They point out that as the interests of British Thomson-Houston and Metropolitan-Vickers in the field of heavy plant are now integrated in A.E.I. Heavy Plant Division it has been necessary to describe the work of the two companies under the side-headings Rugby works (BTH) and Manchester, Trafford Park (M-V).

Hydro-Electric Plant (*Manchester*).—Work is proceeding on the manufacture of six 100-MW, 111,111-kVA vertical waterwheel a.c. generators for the Kariba Power Station for the Federal Power Board of the Federation of Rhodesia and Nyasaland. These machines will operate at 18-kV, 166·7 r.p.m., 0·9 p.f., 3-phase, 50-cycles; they will be driven by Francis-type turbines manufactured by Boving and Co., Ltd., and will be complete with automatic control gear and voltage regulators. Work is programmed for commissioning by January 1, 1960. The last machine will be commissioned on January 1, 1962. Power obtained from these generators will, in the main, be used for supplying the Rhodesian Copper Belt.

Large Machines (*Rugby*).—During the year orders for large motors for general applications were received from both the home and export markets, including three type AGT synchronous motors, each rated 1,330 h.p. at 1,500 r.p.m., for driving centrifugal compressors for the N.C.B.'s Wolstanton Colliery. From Canada an order was received for three 450-h.p. type AKT synchronous motors for driving reciprocating compressors for Alcan for installation in British Guiana. For service in South

African gold mines orders were received for five 1,010-h.p., 750-r.p.m. synchronous induction motors for driving ventilation fans and for four 1,600-h.p. synchronous motors for driving pumps.

Mining Equipment (*Rugby*).—In 1958 some very important mine winder contracts were secured. The largest of these was for four 3,300-h.p. equipments for the West Midlands Division of the N.C.B. These equipments will each consist of a 3,300-h.p. closed-loop, Ward-Leonard, four-rope friction winder, tower mounted. The d.c. 3,300-h.p., 60·1-r.p.m., Type MPC driving motor will be directly coupled to the winder drum shaft and overhung on the drum shaft bearings. The motor-generator set supplying the winder motor comprises a Type MPC 78/56, 2,400-kW generator driven at 500 r.p.m. by a Type 1XT slipring induction motor rated 3,000 h.p. During the year an order was also received for a 900-h.p. ground-mounted twin-rope friction winder, driven by a d.c. motor supplied from a bank of grid-controlled mercury-arc rectifiers. An order was received from the West Midlands Division, for Cannock Wood Colliery, covering a 1,500-h.p. a.c. drum winder equipped with dynamic braking and roter contactor control for speed variation. Two winders have also been ordered for Newdigate Colliery, Bedworth, one 1,300 h.p. and the second 650 h.p.

Dynamic braking control equipment has been ordered for an 800-h.p. winder at Doornfontein Gold Mining Co. and for two similarly-rated winders at Venterspost Gold Mining Co., both for New Consolidated Gold Fields, Ltd.

The three material-handling projects for the N.C.B., North Eastern Division, No. 8 Area, will employ numerous motors and thrustors, controlled by a composite cubicle and multi-motor type control board. Mine-car handling equipment has been ordered for Brodsworth Colliery reconstruction scheme, where the Division is already supplying two 2,700-h.p. tower-mounted Ward-Leonard closed-loop friction winders. The order includes motors and thrusters for operation of rams, stops, catches, platforms, rails and carriages, with the associated control gear arranged for sequence or individual pushbutton control.

(*To be concluded.*)

RECENT PATENTS PUBLISHED

☛A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

6,207 of 1945 (806,739). IMPERIAL CHEMICAL INDUSTRIES, LTD., E. LOFTHOUSE, and J. H. COLLINS. Production of uranium.

18,306 of 1955 (807,715). INTERNATIONAL MINERALS AND CHEMICAL CORPORATION. Method of concentrating potash ores.

23,245 of 1955 (807,514). INSTITUT DE RECHERCHES DE LA SIDERURGIE. Regulation of refining in converters.

27,769 of 1955 (806,973). E. DAMBLY. Densimetric separation of solid materials.

16,621 of 1956 (807,624). STAMICARBON N.V. Process and apparatus for separating solids into fractions according to specific gravity.

28,667 of 1956 (807,889). FARBENFABRIKEN BAYER A.G. Reduction of titanium oxides.

37,406 of 1956 (807,118). ERZBERGBAU SALZGITTER A.G. Magnetic separation of fine-grained pulverulent or dust-like materials.

4,100 of 1957 (807,249). DEUTSCHE GOLD- UND SILBERSCHEIDANSTALT VORM. ROESSLER. Separation of zirconium and hafnium.

NEW BOOKS, PAMPHLETS, ETC.

☛Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

Outline of Historical Geology. By A. K. WELLS. Fourth edition, revised with the assistance of J. F. KIRKALDY. Cloth, octavo, 398 pages, illustrated. Price 32s. London : Thomas Murby and Co.

Mobile Radio Telephones. By H. N. GANT. Cloth, octavo, 125 pages, illustrated. Price 21s. London : Chapman and Hall, Ltd.

Drainage and Use of Methane from Coalfields. Developments since 1956. Paper covers, 112 pages, illustrated. Price 6s. Paris : Organization for European Economic Co-operation.

Plants as a Guide to Mineralization. By D. CARLISLE and G. B. CLEVELAND. Special Report 50 of the California Division of Mines. Paper covers, 30 pages, illustrated. Price 50 cents. San Francisco : Division of Mines.

Kempe's Engineers Year-Book : 1959 (64th edition). Cloth, crown octavo, two volumes, 3,000 pages, in case. Price 82s. 6d. (postage 2s. 6d.). London : Kempe's Engineers Year Book.

Canadian Iron Ore and the North American Iron and Steel Industry. Canadian Mineral Resources Division Map M.R.1. ; Scale, 1 : 10,000,000. Ottawa : Department of Mines and Technical Surveys.

Ontario : Mining Operations in 1956. By D. J. FIELD. 66th Annual Rept. Ont. Dept. of Mines, Part 2, 1957. Paper covers, 170 pages. Toronto : Department of Mines.

Nyasaland : The Geology of the Port Herald Area. By K. BLOOMFIELD. Geological Survey Department Bulletin No. 9. Paper boards, 76 pages, illustrated, with map. Price 10s. 6d. Zomba : Government Printer.

The Engineer Buyers Guide, 1959. Paper covers, 959 pages. Price 7s. 6d. London : *The Engineer*.

Northern Rhodesia : Records of the Geological Survey, 1956. Paper covers, 58 pages, illustrated. Price 5s. Lusaka : Government Printer.

Ghana : Report of the Mines Department, April 1, 1957–March 31, 1958. Paper folio, 20 pages. Price 2s. 6d. London : Crown Agents for Oversea Governments and Administrations.

Sierra Leone : Report on the Mines Department, 1957. Paper covers, 18 pages, illustrated. Price 2s. 6d. London : Crown Agents for Oversea Governments and Administrations.

The Gypsum Deposits of Western Australia : Dept. Mines, Mineral Resources Bulletin No. 6. By L. E. DE LA HUNTY and G. H. LOW. Paper boards, 110 pages, with maps. Perth : Government Printer.

French Equatorial Africa : Geological Map, 1 : 2,000,000, with Explanatory Notes. By G. GERARD. Paris : Librairie Thomas.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE. † Article digested in the MAGAZINE.

Economics

Economic, Africa : *Lime, Tanganyika.* An Impure Gypsum and Dolomite Limestone Deposit at Msagali, Mpwapwa District. A. P. FAWLEY, *Rec. Geol. Surv. Tanganyika*, Vol. V, 1955.

Economic, Africa : *Monazite, N. Rhodesia.* An Investigation of the Source of the Irumi Monazite. P. L. A. O'BRIEN, *Rec. Geol. Surv. N. Rhod.*, 1956.

***Production, Canada :** *Asbestos, Quebec.* An Asbestos Mining Achievement. W. E. SINCLAIR, THE MINING MAGAZINE, Feb., 1959.

Production, Canada : *Iron-Ore, Review.* The Canadian Iron-Ore Industry. M. S. FOTHERINGHAM, *Western Miner*, Dec., 1958.

Production, Canada : *Minerals, Industrial.* Milling Plants in Canada: Industrial Minerals. Canad. Min. Res. Div. Operation List 3, Part 2, July, 1958.

†Production, China : *Asbestos, Review.* Chinese Asbestos. SUN-YI MING, *Canad. Min. J.*, Dec., 1958.

Production, Ireland : *Lead-Zinc, Abbeytown.* Abbeytown Lead-Zinc Mine. W. W. VARVILL, *Mine, Quarry Engg.*, Jan., Feb., 1959.

†Production, United States : *Tin, Alaska.* Lode-Tin Mining at Lost River, Seward Peninsula, Alaska. S. H. LORAIN and others, *Inform. Circ. U.S. Bur. Min.* 7871.

Production, United States : *Uranium, Arizona.* How Western Gold Mines Uranium in Grand Canyon. *Min. World* (San Francisco), Jan., 1959.

Resources, Australia : *Gypsum, Western.* The Gypsum Deposits of Western Australia. E. DE LA HUNTY, G. H. Low, West. Aust. Dept. Mines Bull. No. 6.

†Resources, Brazil : *Diamonds, Review.* Brazil: An Untapped Diamond Source? R. E. MIERITZ, *Min. World* (San Francisco), Jan., 1959.

Resources, Canada : *Iron-Ore, B.C.* Iron Ore in B.C. W. M. ARMSTRONG, *Western Miner*, Dec., 1958.

Resources, United States : *Lead-Zinc, Idaho.* Lucky Friday Mine. W. T. FOLWELL, *Min. Engg.*, Dec., 1958.

Resources, United States : *Mineral, California.* Mines and Mineral Resources of Contra Costa County. F. F. DAVIS, H. B. GOLDMAN, *Calif. J. Min. Geol.*, Oct., 1958.

Resources, United States : *Zirconium, Hafnium.* Zirconium and Hafnium in the South-Eastern Atlantic States. J. B. MERTIE, *U.S. Geol. Surv. Bull.* 1082-A.

Uranium, Price : *Study, United States.* Uranium Adjusts to a Changed Market. *Engg. Min. J.*, Jan., 1959.

Geology

Economic, United States : *Mercury, Arizona.* Geology of the Ord Mine, Mazatzal Mountains. J. W. FAICK, *U.S. Geol. Surv. Bull.* 1042-R.

***Economic, Uranium :** *Mineralization, Witwatersrand.* The Witwatersrand Mineralization. C. F. DAVIDSON, THE MINING MAGAZINE, Feb., 1959.

Regional, Africa : *Port Herald, Nyasaland.* The Geology of the Port Herald Area. K. BLOOMFIELD, Nyasaland Geol. Surv. Bulletin No. 9.

Regional, Africa : *Rukuru, Nyasaland.* The Geology of Part of the Mzimba and Rumpi Districts. W. H. REEVE, Geol. Surv. Nyasaland Report No. 2 (New Series).

Regional, Canada : *Structure, Alberta.* Precambrian Shield Structures, North of Lake Athabasca. J. D. GODFREY, *Canad. Min. J.*, Jan., 1959.

Survey, Geochemical : *Guides, Plant.* Plants as a Guide to Mineralization. D. CARLISLE, G. B. CLEVELAND, Calif. Div. Mines Special Report 50.

Survey, Geochemical : *Studies, United States.* Geochemical Prospecting Studies in the Bullwhacker Mine Area, Nevada. A. T. MIESCH, T. B. NOLAN, *U.S. Geol. Surv. Bull.* 1000-H.

Survey, Geophysics : *Aeromagnetic, United States.* Interpretation of an Aeromagnetic Survey of Indiana. J. R. HENDERSON, I. ZIETZ, *U.S. Geol. Surv. Prof. Paper* 316-B.

Survey, Geophysics : *Electrical, Resistivity.* Practical Evaluation of Electrical-Resistivity Surveys as a Guide to Lead-Zinc Exploratory Drilling, Kansas. L. C. BRICHTON, J. P. RYAN, *Rep. Inv. U.S. Bur. Min.*, 5426.

Survey, Geophysics : *Gold, Tanganyika.* A Geophysical Investigation of Auriferous Reefs in Southern Tanganyika. A. J. KING, *Rec. Geol. Surv. Tanganyika,* Vol. V, 1955.

Metallurgy

†Beneficiation, Iron-Ore : *Jaspilite, Australia.* Pilot Plant for Jaspilite Ore Beneficiation. S. G. SALAMY, *Chem. Engg. Min. Rev.* (Melbourne), Dec. 15, 1958.

Copper, United States : *Mill, Arizona.* Ray Mines Closes Ore-to-Metal Cycle. *Min. World* (San Francisco), Jan., 1959.

***Iron, Recovery :** *Reduction, Direct.* Iron by Direct Reduction. J. GRINDROD, THE MINING MAGAZINE, Feb., 1959.

Uranium, Extraction : *Losses, Solvent.* Determination of Kerosene Entrainment Losses in the Solvent Extraction of a Leach Liquor. C. M. LAPOINTE, Canad. Min. Branch Research Rep. R.25.

Machines, Materials

Aluminium, Structural : *Hazards, Sparking.* Frictional Sparking of Aluminium. J. C. BAILEY, *Trans. Instn. Min. Eng.,* Jan., 1959.

Belts, Conveyor : *Resistance, Fire.* Experience in the Development and Use of Fire-Resistant Belting. H. J. ATKINSON and others, *Trans. Instn. Min. Eng.,* Feb., 1959.

Steel, Alloy : *Properties, Fatigue.* Effect of Shot Peening Prior to Electroplating on the Fatigue Properties of an Alloy Steel. N. B. BROWN, Canad. Mines Branch Research Report R.23.

Mining

Breaking, Blasting : *System, Long-Hole.* Long-Hole Blasting. *Inform. Bull. N.C.B.* No. 58/203.

Breaking, Induction : *Taconite, United States.* Induction Breaking is Patented as a Tool for Taconite Industry. *Engg. Min. J.,* Jan., 1959.

Communications, Mine : *Review, Coal.* Colliery Communications Systems. E. J. KIMMINS, B. L. METCALF, *Trans. Instn. Min. Eng.,* Jan., 1959.

Control, Grade : *Gold, South Africa.* A Study of the Relationship between Development Values and Recovery Grades. D. G. KRIGE, *J. S. Afr. Inst. Min. Metall.,* Jan., 1959.

Handling, Coal. *Safety, Underground.* Safety Aspects of Underground Transport in Coal Mines. A. E. CROOK, *Trans. Instn. Min. Eng.,* Jan., 1959.

***Handling, Hoisting :** *Installation, Skip.* Skip Winder at Rufford Colliery. THE MINING MAGAZINE, Feb., 1959.

Hygiene, Ventilation : *Study, South Africa.* An Empirical Study of Heat Flow in Stopes in South African Gold Mines. J. DE V. LAMBRECHTS, *J. S. Afr. Inst. Min. Metall.,* Jan., 1959.

Mechanical, United States : *Lead-Zinc, Washington.* Transloader Mining. W. M. CALHOUN, *Canad. Min. J.,* Jan., 1959.

Plant, Maintenance : *Review, United States.* Maintenance in 1959. *Engg. Min. J.,* Jan., 1959.

***Power, Air :** *Systems, Efficiency.* Compressed Air Systems. L. WALTER, THE MINING MAGAZINE, Feb., 1959.

Safety, Mine : *Coal, United Kingdom.* Presidential Address: Mine Safety Trends. T. A. ROGERS, *Instn. Min. Eng.,* Jan. 29, 1959.

Stability, Ground : *Rockbursts, India.* Planning and Research Necessitated by Rockbursts in an Underground Shaft. W. R. COWLIN, E. DE STO. ISAACSON, *K.G.F. Min. Met. Soc. Bull.* No. 89: *Mine, Quarry Engg.,* Jan., Feb., 1959.

Supply, Electricity : *Control, Colliery.* An Electronic Indicating System for Mines. W. UNSWORTH, R. F. ELLIS, *Trans. Instn. Min. Eng.,* Feb., 1959.

Ore-Dressing

Cleaning, Coal : *Jig, Mechanical.* The Mechanical Jig in Coal Preparation. G. F. SHRIVES, *Coll. Engg.,* Feb., 1959.

Cleaning, Coal : *Plant, United Kingdom.* Coal Preparation at Manvers Main. *Coll. Engg.,* Feb., 1959.

General, Ireland : *Copper, Wicklow.* Western Europe's Most Modern Flotation Mill. *Min. J.,* Jan. 16, 1959.

General, Mexico : *Lead-Zinc, Chihuahua.* Santa Barbara Mill. D. C. SHELTON, *Bull. Instn. Min. Metall.,* Feb., 1959.

General, Philippines : *Sulphides, Mandanao.* Samar Mining Company, Inc. A. S. YBANEZ and others, *Deco Trefoil,* Nov.–Dec., 1958.

Gravity, Jigging : *Practice, Nigeria.* Recovery of Semi-Heavy Minerals in Jigs. F. A. WILLIAMS, *Bull. Instn. Min. Metall.,* Feb., 1959.

†Gravity, Tin : *Plant, Alaska.* Lode-Tin Mining at Lost River, Seward Peninsula, Alaska. S. H. LORAIN and others. *Inform. Circ. U.S. Bur. Min.* 7871.

Identification, Mineral : *Microscopy, Ore.* Colour Microscopy for the Mill Man. E. P. CADWELL, *Engg. Min. J.,* Jan., 1959.

Separation, Magnetic : *Advances, Current.* Advances in Magnetic Separation of Ores. L. A. ROE, *Min. Engg.,* Dec., 1958.

Separation, Magnetic : *Taconite, United States.* Magnetic Separation for Mesabi Magnetite Taconite. J. E. FORCIEA and others, *Min. Engg.,* Dec., 1958.